JPRS-CAG-84-007

14 March 1984

China Report

AGRICULTURE

HUBEI AGRICULTURAL GEOGRAPHY

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CHINA REPORT

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HUBEI AGRICULTURAL GEOGRAPHY

Wuhan HUBEI NONGYE DILI [HUBEI AGRICULTURAL GEOGRAPHY] in Chinese March 1980 pp 1-264

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FOREWORD

Hubei Province is located in the middle reaches of the Chang Jiang between 108° 30' and 116° 10' east longitude and between 29° 05' and 33° 20' north latitude. It abuts Henan to the north, connects with Anhui to the east, is contiguous with Hunan and Jiangxi to the south and Sichuan in the west, and neighbors Shaanxi to the northwest. China's largest river, the Chang Jiang rolls straight across it, cutting through the famous three gorges natural barrier and flowing through the fertile Jianghan Plain, surging mightily eastward. China's major Jiaozuo-Zhicheng, and Zhicheng-Liuzhou railroads traverse natural chasms running north and south across the whole province. Hubei has always been a land and water transportation hub, and Wuhan has been termed a "thoroughfare to nine provinces," of extremely important strategic significance.

The province has a land area totaling 187,400 square kilometers (or 281.1 million mu), for 16th place in the country. In 1978, the province had 56.52 million mu of cultivated land and a population of 457.5 million of whom 39.06 million were the peasant population. The rural labor force numbered 14.68 million. The inhabitants are predominantly of Han nationality accounting for 99 percent of the total population. Principal minority nationalities are the Tijia, the Hui, Mongolians, and Miao. The province currently has 6 cities under its jurisdiction, namely, Wuhan, Huangshi, Shiyan, Xiangfan, Yichang and Shashi, plus 8 prefectures, namely Huanggang, Xiaogan, Xianning, Jingzhou, Xiangyang, Yunyang, Yichang and Enshi, which contain a total of 72 counties and 1 forest area (the Shennongjia forest zone). It has 1,276 people's communes, 29,505 production brigades and 224,241 production teams. The Hubei Provincial People's Government is located in Wuhan.

The province has extremely advantageous natural conditions. Virtually the entire province is located in the semitropical monsoon climate where sunshine is ample, heat abundant and rainfall copious, suiting it to the growing of numerous kinds of crops. Its landforms include both range upon range of mountains, the western mountain region of the province being suited for development of economic diversification, and vast undulating hill regions suited both to forests and grain production, plus vast tracts of broad and level land famed throughout the country as bases for the production of grain, cotton and oil--the Jianghan Plain. Streams crisscross the territory, and lakes dot the landscape like stars in the sky. The soil is fertile and runs deep, and

water resources are abundant. All this provides favorable natural conditions for the province's development of agricultural production and the modernization of agriculture.

Despite this, during the long period of feudal rule preceding Liberation, and particularly during the cruel oppression and exploitation, and the serious devastation of the Kuomintang reactionary clique, the province's rural villages everywhere presented a picture of misery and desolation. Agricultural production levels were extremely low, and the broad masses of poor and lower-middle peasants lived a life of hardship, driven by cold and hunger.

Following the founding of New China, under the brilliant leadership of the CPC Central Committee and Comrade Mao Zedong, the province's people carried forward the heroic spirit of "the foolish old man who moved the mountain to transform China." They studied the fundamental experiences of Dazhai, adhered to a spirit of "self-reliance and arduous struggle," went in big for capital construction of farmland water conservancy, and effected all-around control of its mountains, waters, fields, forests and roads. Throughout the province was constructed a series of large, medium and small projects for prevention of floods, draining of waterlogging and irrigation. Millions of mu of land were leveled, as much as 1 million mu of low yield fields were transformed, production conditions were steadily improved, and the ability to withstand natural disasters was steadily improved to lay a definite foundation for increased agricultural yields and bumper harvests year after year. In 1978 when Hubei Province sustained an exceptionally severe drought such as history has rarely recorded, a fairly good harvest was brought in nevertheless. Grain output totaled 34.511 billion jin, which was three times more than in 1949; cotton output totaled 73.346 billion jin, 6.4 times the 1949 amount; oil bearing crop output totaled 47.428 billion dan, or 1.8 times the 1949 amount; and hogs in inventory at year's end numbered 17.06 million, about 5.3 times the number in 1949. Substantial development also took place in other economic diversification.

The outlook for the future is magnificent. In the new Long March to the year 2000, the people of Hubei Province are determined to raise high the mighty banner of Mao Zedong Thought under the leadership of the CPC Central Committee, resolutely put into effect the party's line, programs and policies, and struggle to bring about the modernization of agriculture within this century!

Part I. General Discussion

Chapter 1. Natural Conditions and Agricultural Resources

First Section. Agricultural Landforms

Hubei Province is located on the eastern fringe of the secondary terraces in China, where the land is characterized by multitiered circular shaped individual bands, and the types of landforms are fairly complex and varied. They are favorable for the all-around development of farming, forestry, animal husbandry, sideline occupations and fisheries, and provide fine conditions for agricultural production and crop patterns. At the same time, however, some landforms that are not favorable for agricultural production also exist and must be given earnest attention in the building of agricultural production.

1. General Lay of the Land and an Evaluation of It

The west, north and eastern parts of the province are ringed by Wuling Shan, Wu Shan, Daba Shan, Tongbo Shan, Dabie Shan and Mufu Shan. Only the south is broad and flat and contiguous with the plain of the Dongting Hu. The overall lay of the land is generally high on three sides, low and flat in the middle, and stretches out southward in an incomplete basin.

The basin in Hubei Province is a part of the basin of the middle reaches of the Chang Jiang (also known as the Central China Basin). Its low portions are the broad and level Qianghan Plain. This is a part of the area that has tremendously subsided since the Mesozoic Era, and Tertiary and Quarternary System strata spread widely. History records that as long ago as the Spring and Autumn Period, B.C. 770-476, this was a huge lacustrine marshland, namely the "Great Yunmeng Marsh." Over time, the flooding and alluviation of the Chang Jiang and the constant extension of the Jianghan inland delta, plus the gradual silting and merging formed a widespread lacustrine accumulation and an alluvial plane at an elevation of more than 50 meters above sea level. The terrain slopes gently from the northwest eastward, the land sloping only a general 1 to 2 degrees. It is flat and broad, intersected by streams, dotted with lakes, and crisscrossed with protective lake embankments, making it suitable for mechanized cultivation.

Toward the outer edges of the Jianghan Plain, the land begins to rise little by little to the mostly mountainous surrounding area.

The west (generally westward from a line running through Guanghua, Nanzhang and Yichang) is a part of a violently raised area that was tremendously thrust upward since the Cenozoic Era, and most of it is mountainland more than 1,000 meters above sea level. From northwest Hubei all the way to southwest Hubei are countless mountains, range upon range in unbroken succession that are collectively termed Hubei's western mountains. The general configuration of the land consists of three parts, namely the mountains of northwestern Hubei, the mountains of southwestern Hubei, and the mountains of the three

gorges of the Chang Jiang. The mountains of northwestern Hubei are formed by an eastern extension of the Qingling mountain chain, the Wudang mountain chain, the eastern part of the Daba Shan and the Jing Shan range. The mountain ranges advance mostly from east to west or from northwest to southeast. The overall lay of the land is high in the west and low in the east, high mountains opposing each other south and north with the Han Jiang Valley in between. The Han Jiang enters Hubei from western Shaanxi and flows eastward between the Qinling and the Daba mountains to form a landscape in which canyon and basins alternate. Fairly large basins are the Xunyang and Junxian basins, and in the basins are deposits of sediment from the Tertiary System, the Red Rock System, and the Quarternary System. The rocks are principally limestone, phyllite, slate, sandstone and schist. The mountain ranges lend themselves to forestry and mountainland specialties, and on Dashennongjia (at an elevation of 3,052 meters above sea level), which is known as the primary peak in central China, the forests are dense. This is an important forestry base in Hubei Province.

The mountains of southwestern Hubei are an eastern extension of the Yunnan Plateau. Going from southwest to northeast, the Qiyue range, the Bamian range, and the Wuling range form a topography that is high in the west and low in the east. Numerous tributaries traverse the area to enter streams such as the Qing Jiang-Quarternary system deposits consist mostly of eluvium and drift bed. Rocks are limestone and shale for the most part. Since limestone is distributed fairly widely, the karst topography is fairly well developed with numerous hollowed out caves, underground streams, box canyons, dissolution lowlands and such peculiar landscapes, with numerous subsidence basins among the mountains.

The three gorges of the Chang Jiang that link northwestern Hubei with southwestern Hubei are formed from a series of folded mountain ranges that run basically from north to south including the Wu Shan. In its flow eastward, the Chang Jiang cuts through the Wu Shan to form the mighty and majestic three gorges of the Chang Jiang, with a mass of peaks tall and straight and deep canyons that are distinctive landforms. One of them, the Xiling Gorge, lies within Hubei Province with an average width of 250-350 meters. This area is greatly screened by high mountains, so its climate is temperate, suiting it to development of semitropical fruit trees.

Northwestern Hubei and southeastern Hubei belong to the newly formed uplifted zone in which movement has ranged from the slight to the violent. Most of it is low mountains and hills below 1,000 meters above sea level. From the western section of the Tongbo range in northeastern Hubei, they extend all the way to the eastern section of the Dabie range in an unbroken chain across Henan, Hubei and Anhui that forms a horizontal division running from the northwest to the southeast making a watershed between the Chang Jiang and the Huai He. Structurally, it is a part of the ancient Huaiyang geology. During the period of the Yan Shan movement of the Mesozoic Era, large quantities of acidic magma intruded giving rise to fissuring to form a series of basins among the mountains. Sediment in the basins contains large amounts of chalk of the Tertiary System and the Red Rock System, which formed surface rock, notably granite and gneiss. Since these rocks are easily weathered and corroded, the

surface is extremely broken up, and since torrential rains occur frequently, the area is extremely prone to serious soil erosion.

From west to east in southeastern Hubei is the Mufu mountain range, which is a folded mountain area formed during the Yanshan movement. It extends generally from southwest to northeast in the mountains that separate Hubei from Hunan and Jiangxi. The entire topography is high in the south and low in the north, parallel mountain ranges and valleys alternating. In the south are mostly intensely cut up mountains of intermediate and low elevation and hills made of granite that have weathered greatly and where soil erosion is fairly serious. In the north, hills dominate. The land surface is mostly limestone, which is heavily karstic.

Hills and hillocks are generally distributed all around the Jianghan Plain and among the mountains as, for example, the hillocks of northern Hubei, which are the dividing line between the Tongbo Shan and the Wudang Shan.

In Hubei Province, the general lay of the land of basins with multitiered circular bands is extremely closely related to development of water conservancy resources for use as follows: (1) The numerous streams within the province rush headlong downward from the edges of the mountain ranges converging in the Chang Jiang to form a nexus water system whereby the entire province is virtually a part of the Chang Jiang water system. The amount of water in these large and small streams is copious and its gradient is fairly steep. Water power resources are abundant, favoring step development. (2) The multitiered circular landforms favor the level by level retention of surface runoff and development of gravity irrigation. In the mountains and hills, reservoirs and mountain pools may be built, and the water guided for irrigation. However, the circular landforms frequently give rise to basins (in plains areas) where large amounts of runoff intensify the convergency of water making it easy for flood and waterlogging disasters to occur. (3) As a result of the widespread and thick interlacing of gravel and clay layers during the Quarternary Era, the Jianghan Plain has numerous layers of aquifers with large quantities of water stored not far below the surface. This confined water is abundant, and its quality very good. It provides fine supplementary conditions for underground runoff on the Jianghan Plain, and helps develop the Jianghan Plain's underground water resources.

Hubei Province's basin terrain has marked effect on climate. The end of the Qinling range, the Tongbo range, and the Dabie range spread uninterruptedly northward to form a natural climatic screen, which functions to obstruct cold area which heads south. Consequently, the intensity of drops in temperature is moderated. This is also a major reason why the valleys of northwestern Hubei are able to develop citrus fruits. The north is connected with the Nanyang Basin only by the "Xiangdang Corridor" where, since the terrain is flat, cold air from the north sails directly through this corridor and penetrates deeply into the Jianghan Plain forming a tongue that protrudes southward into the warm line during the winter season. Both autumn cold and spring cold occur with greater frequency here than in eastern or western Hubei. Winter cold comes early and spring cold is long in leaving. In addition, the province's landforms also have a definite effect on the amount of precipitation it receives.

2. Major Types of Landforms and Agricultural Patterns

Hubei Province's landforms differ greatly in height, are of many shapes, and are complex and varied. In terms of elevation above sea level, and shapes, they may be divided into four basic types, namely mountains, hills, uplands and plains. (see Figure 1)

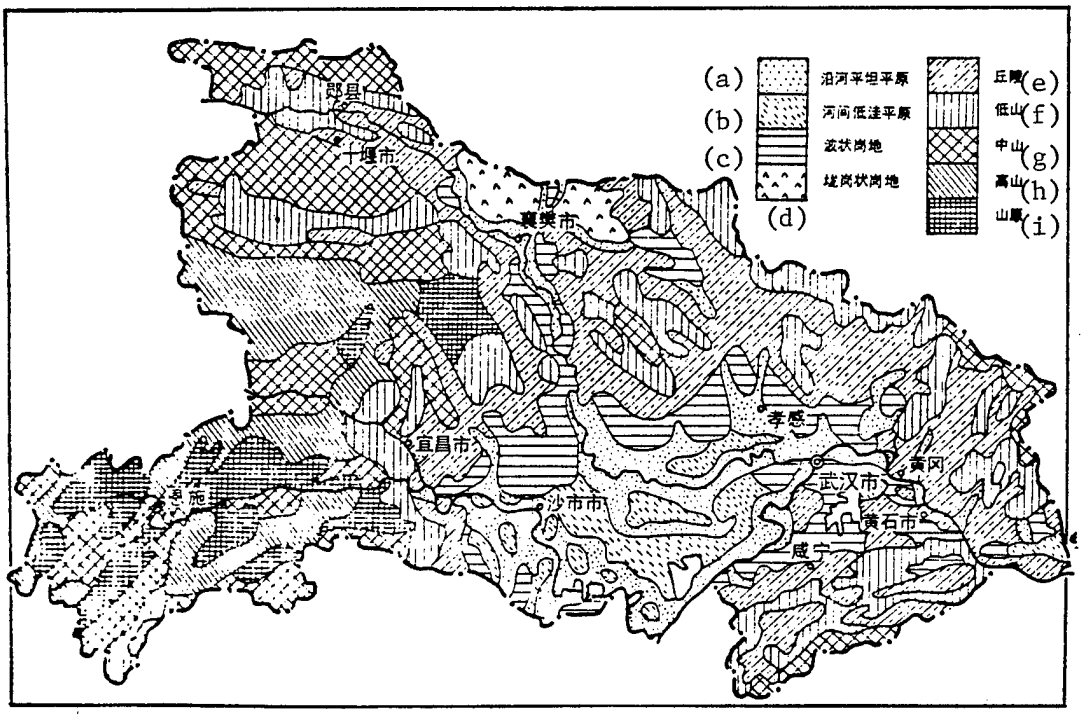

Figure 1. Types of Terrain in Hubei Province

Key:

a. Flat plains along rivers
b. Lowlying plains between rivers
c. Sloped uplands
d. Ridged uplands
e. Hills
f. Low mountains
g. Medium mountains
h. High mountains
i. Mountain plateaus

Mountains: Mountains are usually more than 500 meters above sea level, and they are the largest kind of landform in the province covering 156.73 million mu or about 56 percent of the total area of the province. This includes not only low mountains (at an altitude of from 500 to 800 meters above sea level), medium mountains (also termed second grade high mountains at an altitude above sea level of 800-1,200 meters), and high mountains (more than 1,200 meters above sea level), but also includes some mountain plateaus such as the Lichuan Plateau in southwestern Hubei. Between mountains are subsidence basins (such as the Enshi Basin and the Jianshi Basin) and river valleys also cut through the mountains--alluvial plains.

Low mountains are distributed mostly in northeastern and southeastern Hubei, the former being predominantly perfectly round low mountains composed of granite or gneiss, and the latter being large numbers of low flat topped mountains capped with limestone. In addition, some gently sloping low mountains and some precipitous low mountains are scattered here and there. Medium size and high mountains are concentrated largely in the western parts of Hubei Province.

Hills and uplands: Hills and uplands are usually between 100 and 500 meters above sea level. They total 68.18 million mu or about 24 percent of the province's area. This includes hills (250-500 meters above sea level), which are distributed around the outer edges of the Jianghan Plain, and are found mostly in central and northeastern Hubei. They may be distinguished in terms of relative elevation as low hills (with a relative elevation of less than 50 meters), and high hills (with a relative elevation of more than 50 meters). Currently virtually all low hills with gentle slopes have been brought under cultivation. Uplands may be divided into two categories; ridged uplands and sloped uplands. The former occur mostly in northern Hubei, and the latter are scattered fairly extensively. In northern Hubei, the uplands have been formed through the cutting of newly uplifted drift deposits during the Quarternary Era. The surface of the land is rather undulating; the tops of uplands are relatively flat; and the soil layer is fairly deep.

Plains: Plains are less than 100 meters above sea level, and those whose elevation is no greater than 20 meters are fairly flat lands. There are 56.2 million mu of plains in the province accounting for about 20 percent of its total area. Mostly they are accumulation plains formed by depressions during the Tertiary Era and deposits during the Quarternary Era. They include plains along rivers and lowlying plains between rivers. The terrain rolls but little on the plains and the soil layer is thick. They are the most favorable kind of terrain in the province for the development of agricultural production.

As a result of differences in elevation above sea level, gradient of slopes, and the materials from which the surface of the land is formed in the foregoing kinds of terrain, not only do conditions for cultivation differ markedly, but the further distribution of sunlight, heat and water are restricted, thereby deeply affecting agricultural production and crop patterns as a whole. In the province's western mountains, the land is high, the slopes precipitous, the rising and falling of the terrain great, and the layer of soil thin. This greatly restricts development of farming; little of the land has been cleared for agriculture; and the ratio of drylands to cultivated land as a whole is fairly large. In the eastern hill regions, by contrast, since the surface of the land slopes but little and the soil layer is fairly thick, the ratio of wetlands to cultivated land as a whole is fairly large. Since the topography of the Jianghan Plain is flat, water resources ample, the soil layer thick, and the soil fertile, farming conditions are extraordinarily favorable.

The effect of topography on farm crop patterns is very obvious. Along the eastern fringes of the western mountains of Hubei, for example, in mountain areas above 800 meters the principal crops are dryland corn and potatoes. In

low mountains between 500 and 800 meters, the amount of paddy rice grown increases gradually, and the growing of dryland crops declines relatively in hill regions between 200 and 500 meters, paddy rice and wheat, barley, or naked barley are the principal crops. Below 200 meters, the proportion of double crops of rice markedly increases. Even on the Jianghan Plain where the terrain is flat, the effect on farm crop patterns of some undulation in the terrain in small areas cannot be ignored.

The diverse types of terrain in Hubei Province have brought about a land utilization situation of "70 percent mountains, 10 percent water, and 20 percent fields." In the hilly regions of northern Hubei there are numerous fields relative to population, and at the present time the level of agricultural production there is relatively low and the potential for production fairly great. In northeastern Hubei where mountain ranges exist in unending succession and where mountain chains alternate with valleys, water and heat are abundant. This area lends itself both to the growing of grain and to forestry, and is currently the region of the province that produces some of the highest grain yields per unit of area. Southeastern Hubei is the province's major area for production of bamboo, Chinese fir, tea and hemp. The western mountains of Hubei are also an ideal place for the province's building of forests and bases producing special mountain products. It is simultaneously a natural pasture. Its basins and its river valley plains make it a local "granary." On the Jianghan Plain, the numerous lakes that dot the landscape and the large numbers of newly built reservoirs in hill and low mountain areas are extremely favorable for development of the fishing industry. Hubei Province has more than 7 million mu of water surfaces for the breeding of all kinds of aquatic products, and it is one of the country's province's having the largest freshwater breeding area.

Second Section. Agricultural Climate

Hubei Province has a semitropical monsoon climate with plenty of sunshine, abundant heat, a long frost-free period, and copious rainfall, with rainfall and warmth occurring during the same season. This provides superior climatic conditions for agricultural production. However, there are also some unfavorable climatic conditions that limit full use of climate resources.

1. Agricultural Climate Resources and Characteristics

(1) Abundant Sunshine and Great Potential for Photosynthesis

Solar radiation is a most fundamental climatic factor. The amount of sunshine and solar radiation is extremely closely related to crop growth and development, and crop yields. Studies show that between 90 and 95 percent of plant material derives from the fixing of carbon dioxide through photosynthesis, and that only between 5 and 10 percent derives from soil nutrients. Hubei is located at mid-latitude where the hours of sunshine and the amount of solar radiation reaching the surface of the ground is substantial, varying at different places and at different times. (see Table 1-1) The province averages 1,150-2,245 hours of sunshine annually, i.e. between 28 and 50 percent of the time (see Figure 2), and 87-122 kilocalories per square centimeter[1] of radiation annually. In general, amounts gradually increase from the southwest to the northeast, the north getting more than the south. At Macheng in northeastern Hubei, for example, sunshine averages 2,245 hours annually, and radiation totals 122 kilocalories annually. Zaoyang in northern Hubei gets 2,202 hours of sunshine and 120.4 kilocalories of radiation. At Honghu on the Jianghan Plain, the amounts drop to 1,969 hours of sunshine and 114.2 kilocalories of radiation. At Xuanen in southwestern Hubei, amounts are even less, being 1,157 hours and 87.8 kilocalories respectively. This shows that except for southwestern Hubei where both sunshine and solar radiation are fairly abundant, the Dabie Shan and the Dahong Shan areas get the most of both. In terms of season, light energy resources are greatest during summer and least in winter. For example, during summer, Suixian gets 34 percent of the average amount of sunshine for the year as a whole, and 35 percent of the total amount of radiation. In winter, by contrast, it gets 19 percent and 16 percent, respectively. Amounts differ but little between spring and autumn when both sunshine and solar radiation amount to between 23 and 26 percent of the annual total. In summer light energy is abundant, and the daylight period when photosynthesis occurs is long. This helps the synthesis of carbohydrates, and is extremely favorable for summer crops such as paddy rice. On the central plain and hill regions of eastern and central Hubei, the autumn sky is clear, the air crisp, and the sunlight brilliant. This plays a fine role in increasing cotton output and quality as well as in the growth of crops that are harvested in the fall.

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1. Except where noted in this book, total amount of solar radiation is calculated values, and units are kilocalories per square centimeter. The term per square centimeter will be omitted hereafter.

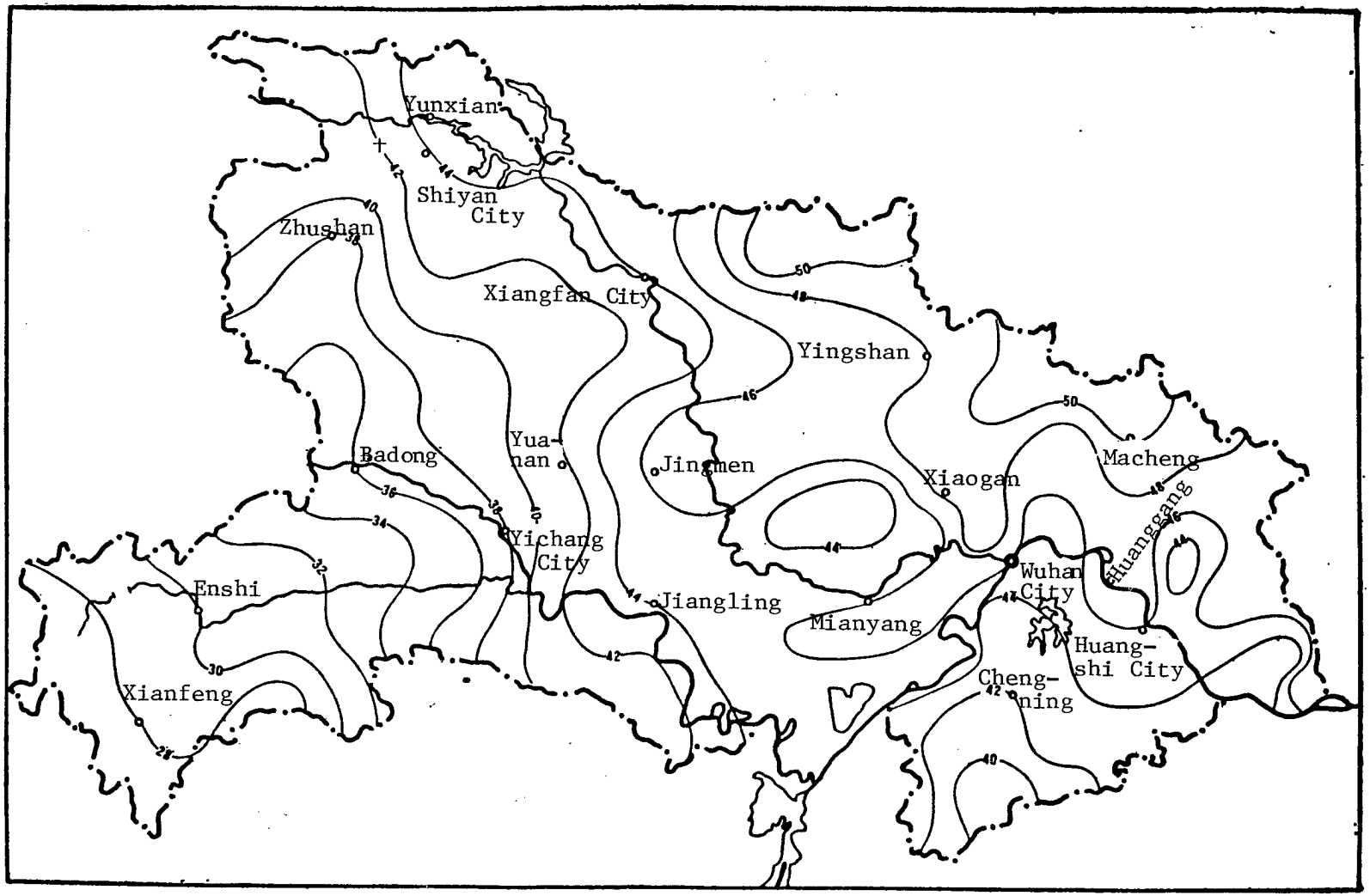

Figure 2. Map Showing Percentage of Sunshine in Hubei Province

Table 1-1 Solar Energy Resources at Various Places in Hubei Province

(a) 光能资源 \ (b) 地方	(c) 麻城	(d) 英山	(e) 枣阳	(f) 洪湖	(g) 崇阳	(h) 郧县	(i) 五峰	(j) 恩施
(k) 年平均日照(小时)	2,244.9	2,115.6	2,201.6	1,969.2	1,779.6	1,972.4	1,593.7	1,352.0
(l) 年辐射总量 (千卡/厘米^2)	122.0	120.4	120.4	114.2	106.9	113.1	101.0	93.7
(m) 全年光合潜力 (植物质斤/亩)	15,104	14,906	14,906	14,138	13,234	14,002	12,504	11,600
(n) 4—10月日照(小时)	1,507.2	1,428.7	1,460.1	1,362.0	1,258.6	1,310.9	1,121.2	1,031.3
(o) 4—10月辐射总量 (千卡/厘米^2)	87.0	82.3	86.0	71.8	78.4	79.9	73.2	70.2
(p) 4—10月光合潜力 (植物质斤/亩)	10,771	10,189	10,653	8,889	9,706	9,892	9,062	8,691

Key:
a. Solar energy resources
b. Place
c. Macheng
d. Yingshan
e. Zoayang
f. Honghu
g. Chongyang
h. Yunxian
i. Wufeng
j. Enshi
k. Average annual amount of sunshine (hours)
l. Total amount of radiation annually (kilocalories per square centimeter)
m. Photosynthesis potential for the whole year (jin per mu of plant material)
n. Amount of sunshine between April and October (hours)
o. Total amount of radiation between April and October (kilocalories per square centimeter)
p. Photosynthesis potential between April and October (jin per mu of plant material

The abundant light energy resources hold huge potential for increases in yields. Under most suitable conditions, crops with high efficiency in photosynthesis in Hubei Province could produce between 11,000 and 15,000 jin per mu of plant material annually with a 15 percent water content, which is the photosynthesis potential for the year as a whole. The photosynthesis potential between April and October amounts to 8,000-10,800 jin per mu. Of the total photosynthesis potential, a substantial portion is difficult to use during the winter season because of the limitations of low temperatures. Between April and October, however, the effects of unfavorable factors are relatively few, and it is during this period that the photosynthesis potential can be used to the fullest. Were it possible to make full use of the foregoing photosynthesis potential, grain yields in Hubei Province could reach

4,400-6,000 jin per mu,[1] and double crop paddy rice yields could reach 3,200-4,300 jin per mu. At the present time, continuous cropping of two rice crops in Hubei Province can reach the highest total output figure for early rice and late rice on the Jiangping Plain by using only 43.3 percent of the photosynthesis potential. Efforts should be made to explore the factors limiting fullest use of photosynthesis potential, and to strive to make new breakthroughs in use of photosynthesis potential.

(2) Abundance of Heat Favors Farm Crop Growth

Heat is a major requirement for the growth and development of farm crops. It affects and determines plants' organic life processes. In Hubei Province, the annual temperature averages 15-17°C, and cumulative temperatures for days when temperatures average >10°C range between 4,800 and 5,700°C. The frost-free period is 230-290 days. Heat energy is abundant, favoring farm crop growth.

1. Cumulative Temperature When Daily Temperatures Average >10°C

Usually the accumulation of average daily temperature--the variable cumulative temperature (or cumulative temperature, for short) is used as an indicator of heat energy for farm crops. In Hubei Province, the general trend of distribution for cumulative temperature when daily temperatures average more than 10°C is great in the south and less in the north. Only in the west is the situation somewhat complicated by the effects of topography (see Figure 3). Except for mountain areas, cumulative temperature in northern Hubei is least at between 4,800 and 5,000°C, and greatest in the river valleys of the three gorges where cumulative temperature is greater than 5,500°C (or as high as 5,690°C). In other areas, it is 5,000-5,300°C.

Heat energy conditions in Hubei Province are also fairly favorable for increasing the multiple cropping index. Cumulative temperature where daily temperatures average more than 10°C can be assured 80 percent of the time in river valleys along the Chang Jiang in both eastern and western Hubei, which have a cumulative temperature of more than 5,200°C fairly consistently. On the Jianghan Plain and in the Qing Jiang river valley, a cumulative temperature that is higher than a 4,900°C occurs fairly consistently. In northern Hubei and in Hanjiang river valley, they are higher than 4,300°C. Average daily temperatures that can be assured 80 percent (or more) of the time to be 10°C on the first day and 20°C on the last day occur in river valleys along the Chang Jiang in eastern and western Hubei where cumulative temperature is above 4,300°C. On the Jianghan Plain, the cumulative temperature is above 4,200°C; in the Qing Jiang river valley, it is more than 4,000°C, and in northern Hubei and northwestern Hubei it is more than 3,900°C, being less than 3,600°C only in certain years. Comparison of the foregoing heat energy conditions with cumulative temperatures required by the principle varieties of double cropped rice grown in the province (see Table 1-2) shows that heat energy can be assured from sowing until full heading by early rice, and

1. Grain weight figured at 40 percent that of plant material (inclusive of stems, leaves and grain).

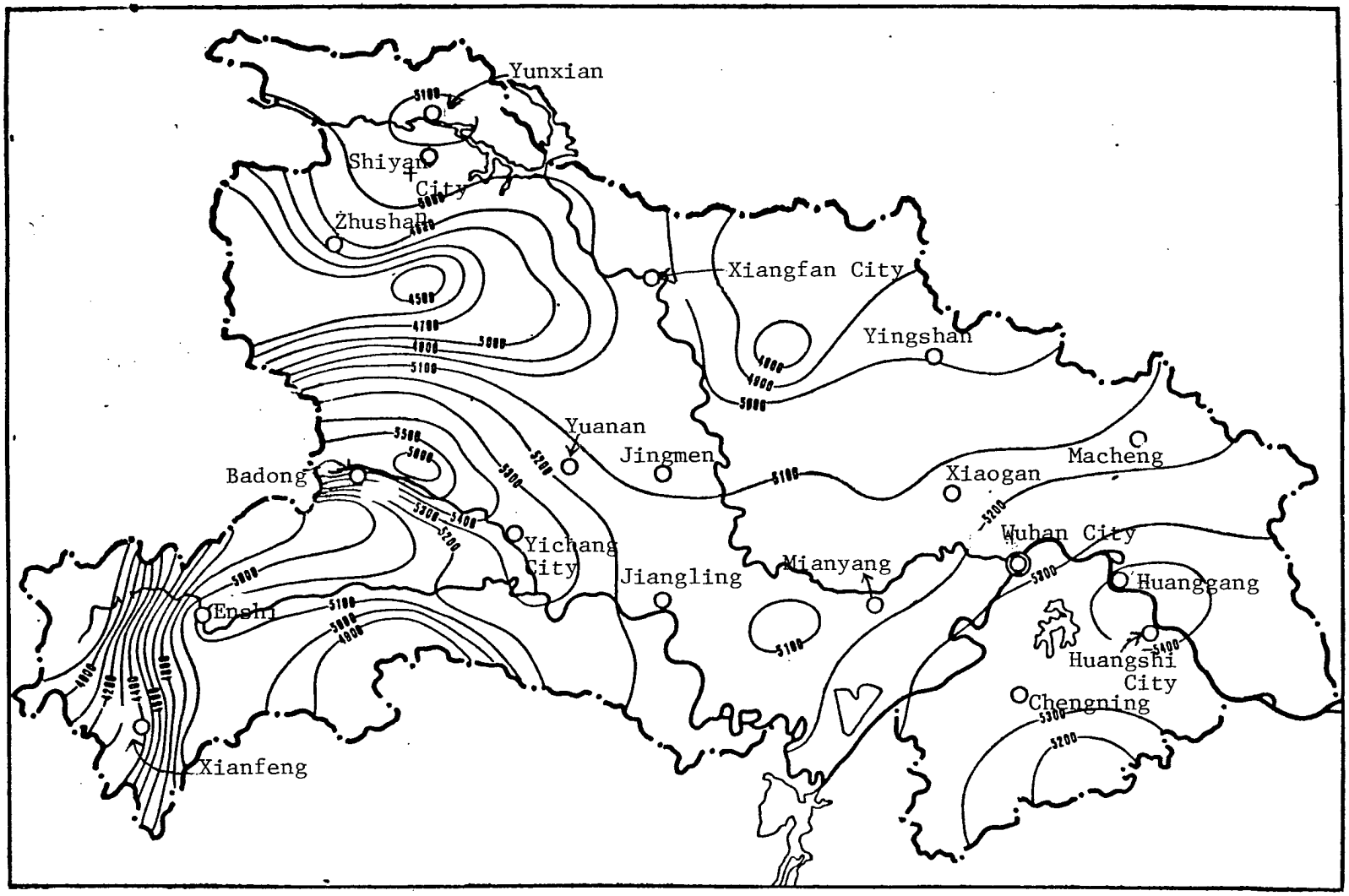

Figure 3. Cumulative Temperatures for Average Daily Temperatures Greater Than 10°C in Hubei Province

Table 1-2 Cumulative Temperature (°C) > 10°C During Development of Early and Late Rice

(a)早稻品种 \ (b)生育期	(c)播种—成熟 (d)日数	(c)播种—成熟 (e)积温	(f)晚稻品种 \ (b)生育期	(g)移栽—齐穗 (d)日数	(g)移栽—齐穗 (e)积温	(h)移栽—成熟 (d)日数	(h)移栽—成熟 (e)积温
(i)广陆矮4号(中熟)	116	2,571	(l)沪选19号(中熟)	52	1,454	91	2,200
(j)二九青(早熟)	106	2,220	(m)农垦58(迟熟)	63	1,644	107	2,458
(k)华矮15号(中熟)	110	2,330	(n)鄂晚3号(迟熟偏早)	56	1,546	100	2,380

Key:
a. Early rice variety
b. Period of development
c. Sowing-maturity
d. Number of days
e. Cumulative temperature
f. Late rice variety
g. Transplanting-full heading
h. Transplanting-maturity
i. Guangluai No 4 (intermediate ripening)
j. Erjiuqing (early ripening)
k. Huaai No 15 (intermediate ripening)
l. Luxuan No 19 (intermediate ripening)
m. Nongken 58 (late ripening)
n. Ewan No 3 (somewhat early late ripening)

throughout the entire period of development of double crops of rice. In river valleys along the Chang Jiang in eastern and western Hubei, heat energy conditions are best, and requirements of all mixes of early, intermediate, or late maturing rice can be substantially satisfied. These are superior areas for the development of a three crop system. Heat energy on the Jianghan Plain and in the Qing Jiang valley satisfy requirements of late maturing early rice or late maturing intermediate varieties, and opens the way for development of a crop pattern of green manure-rice-rice, or oil-bearing crop-rice-rice. Heat energy in the Han Jiang valleys of northern and western Hubei can only meet the needs of matched varieties of intermediate maturing early rice or intermediate maturing intermediate rice. Of course, development of double crops of rice requires not only sufficient cumulative temperature, but also farming as the season requires in order to assure proper temperatures during their periods of development.

It should be noted that inasmuch as summer temperatures in river valleys in low mountain and mountain areas are lower than on the plains, even if variable cumulative temperature is about the same, effective cumulative temperature is less than on plains. For example, in Enshi, variable cumulative temperature above 10°C is 62°C more than in Jiangzhou, but effective cumulative temperature is 66°C less. Variable cumulative temperature above 10°C in Badong is 150°C more than in Huanggang, but effective cumulative temperature is virtually identical. This is one of the main reasons why the season for development of farm crops is later in mountain areas than on the plains.

2. Frost-free Period and Sustained Number of Days at Various Temperature Limits

The frost-free period is closely related to the farmcrop growing season, and is an indicator for determining heat energy conditions. In Hubei Province, the frost-free period is longer in the south than in the north (see Figure 4). In northern Hubei, it is about 230 days; on the Jianghan Plain it is 250-270 days; and in river valleys of the three gorges of the Chang Jiang, it is longest at more than 290 days, with 308 days at Zigui. In mountain areas, the number of frost-free days declines with altitude as, for example, at Lichuan (1,100 meters above sea level) where it is 230 days, and at Lucongpo in Badong (1,800 meters), where it is less than 210 days.

In agricultural climatology, a sustained period of average daily temperatures of >5°C (or >3°C) is termed the crop growing season of the plant season. In Hubei Province, the period of sustained temperatures greater than 3°C is 340-350 days in valleys of western Hubei. At Enshi, temperatures are above 3°C all year round. In other places, it is about 320 days. The sustained period of temperatures >10°C is when crop growth fluorishes. This period runs from 240 days in the south to 230 days in the north of the province. In river valleys in eastern Hubei and in warm valleys of southwestern Hubei, this period may be more than 245 days. It is shorter in mountain regions. The period when temperatures remain at greater than 15°C is the time of prolific growth of heat loving crops. On the Jianghan Plain and in river valley areas, this period lasts for more than 190 days. On the eastern plains and near Badong and Enshi, it is more than 200 days. In all other places it is 180-190 days. Lucongpo has only 80 such days.

The foregoing shows that in terms of heat energy conditions, for most parts of Hubei Province the crop growing season is fairly long. It not only can accommodate a two crop per year system, but provides fine conditions for development of a three crop system.

3. Overwintering Conditions

The average value of the absolute lowest temperature each year for many years is the criterion for evaluating the severity of winters (or the overwintering conditions). Its frequency of occurrence, and its certainty point to the chances of low temperatures occurring each year. It determines the limits of cultivation of winter crops and of perennial woody plants. According to meteorological data prior to 1975, the average value for lowest temperatures in Hubei Province and the frequency and certainty with which low temperatures occurred at all levels over the years (see Table 1-3) in terms of low temperature extremes was -10°C to -15°C in most areas, with the exception of river valleys in low mountains of southwestern Hubei where temperatures were -5°C to -7°C. Places with the lowest extreme of temperature included Hankou. Tianmen, Yijialing in Jingshan County and Nanzhang, where the temperature was below -17°C, and Hongshan in Sui County where the temperature was even lower at -21°C. This shows that semitropical fruit trees such as citrus could hardly overwinter on the Jianghan Plain and northern Hubei, while more superior overwintering conditions exist in the counties of river valley areas in southwestern Hubei.

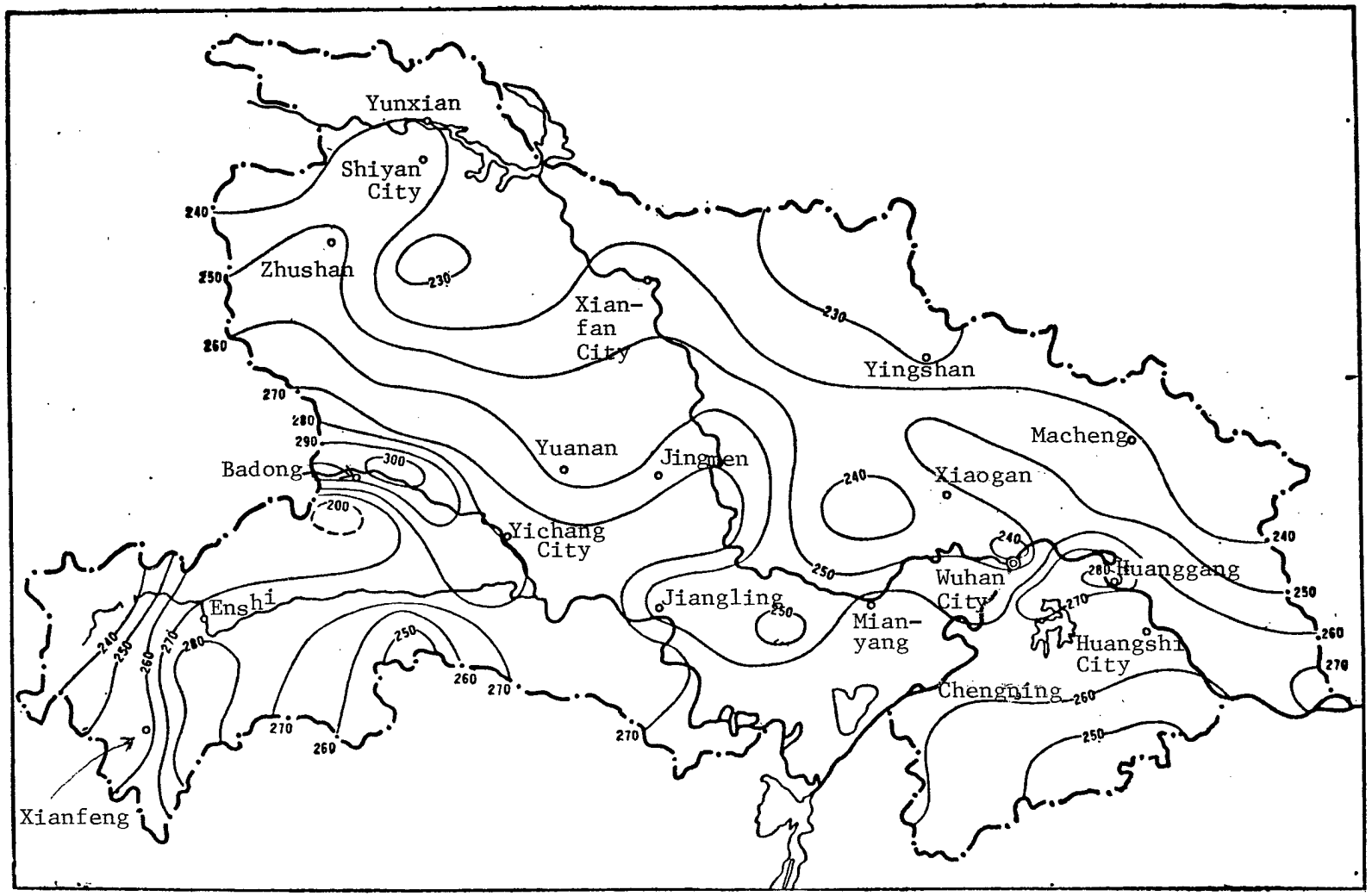

Figure 4. Map Showing Distribution of Frost-free Periods in Hubei Province

Table 1-3 Frequency and Certainty of Absolute Minimum Average Temperature and Low Temperature at Each Level Over the Years (Data as of 1975)

(a) 站名	(b) 平均值(℃)	(c) 频率 (%)				(d) 保证率(%)		(e) 极端最低
		>-6℃	-6℃— -8.9℃	-9℃— -12.9℃	<-13℃	>-7℃	>-9℃	(℃)
Laifeng	-4.0	100				100		- 5.7
Hefeng	-3.9	100				100		- 4.9
Lichuan	-6.8	25	75			50	100	- 8.5
Badong	-2.5	100				100		- 5.3
Enshi	-3.1	100				100		- 5.2
Yidu	-5.4	73	9	18		73	82	-10.9
Changyang	-4.5	82	9	9		82	91	-10.0
Yichang	-4.6	84	16			84	100	- 8.9
Zigui	-2.4	100				100		- 5.6
Dangyang	-7.1	33	59	8		50	92	-12.3
Songzi	-5.4	69	23	8		77	92	-10.8
Gonqan	-5.6	69	23	8		77	92	-10.9
Shishou	-7.1	58	25	17		66	83	- 9.8
Yunxian	-7.0	28	66	6		45	94	- 9.4
Zhushan	-6.4	47	40	13		73	87	- 9.9
Fangxian	-9.4		69	23	8	23	69	-14.4
Nanzhang	-8.8		73	18	9	18	73	-17.2
Yicheng	-7.8	21	64	7	7	21	86	-14.1
Xianning	-7.9	46	31	15	8	69	77	-15.4
Echeng	-6.5	50	42	8		58	92	-12.4
Yangxin	-7.5	31	46	15	8	54	77	-14.9
Puche	-8.0	25	33	33	8	42	58	-14.6
Tongshan	-8.0	7	64	21	7	28	71	-13.3
Chongyang	-8.5	20	53	7	20	40	73	-14.9
Tongcheng	-6.7	64	18	9	9	64	82	-15.2
Guangji	-6.9	58	25	8	8	58	83	-13.8
Hankou	-9.3	15	40	30	15	30	55	-17.3

Key:
a. Station name
b. Average value (°C)
c. Frequency (percent)
d. Certainty (percent)
e. Lowest (°C)

In consequence of the intrusion of a powerful cold wave in January 1977, except for southeastern Hubei, most parts of the province sustained the lowest temperatures on meteorological record.[1] Furthermore, they continued for a long period, and even in the river valleys of southwestern Hubei, which are noted for their warm winters, extremely low temperatures fell below -7°C and even to -9°C. At Zigui, for example, the temperature was -8.9°C, -9.4°C at Badong, and at Enshi at a fairly high elevation above sea level -12.3°C, causing quite serious freeze damage to the citrus. Climatic changes posed new research problems for people.

As a result of preliminary survey and analysis of this freeze damage in recent years, the original pattern of citrus cultivation in Hubei Province has continued to be affirmed as basically rational. At the same time it has been explained further that even areas having fine overwintering conditions must be sure to adapt general methods to local circumstances in the growing of semitropical fruit trees, and select tracts of land suited to their cultivation. An old farmer's saying goes, "When the snow line descends on high mountains, frost will sweep the lowlands." Lowlands and valleys are prone to the accumulation of cold air and are relatively frigid, while between 50 meters from lowlands at the foot of mountains up to mid level on the mountains, and particularly in temperature stretches on southern slopes, citrus may be cultivated. In addition, in areas close to bodies of water such as around reservoirs, the microclimate is improved as a result of the regulating role of the water bodies' latent heat. Here the climate is fairly moderate, and winter temperatures do not drop too low. Such places are suited for development of citrus production.

(3) Copious Precipitation, But Fairly Great Variations

Hubei Province is located in the monsoon zone in which there are four clearly demarcated cold, warm, dry and wet seasons. Rainfall is concentrated during the summer season when temperatures are high, which is most favorable for the growth of high yield crops such as paddy rice. However, variations in the amount of rainfall are also fairly great, and the amount of precipitation is not consistent, with the result that drought or waterlogging disasters may occur.

1. Annual Amount and Distribution of Precipitation

Hubei receives copious precipitation, the amount averaging from 800 to 1,600 millimeters annually, and as much as 1,800 to 2,200 millimeters in mountainlands. Rainfall is greatest in southeastern and southwestern Hubei where it is more than 1,400 millimeters. It is least in the northwestern mountain regions and the northern hills of the province where it is below 900 millimeters. In other places it is between 900 and 1,400 millimeters (see Figure 5). The general trend is gradual decrease from south to north; however, as a result

1. According to data from the Meteorology Center in Wuhan City, and the Yichang Meteorology Station, 1977 was the coldest year during the past 70 to 80 years, and in January record low temperatures occurred, -18.1°C in Wuhan and -9.8°C in Yichang.

of the effects of terrain and altitude above sea level, a fairly complex situation exists in mountain regions. Areas of scant rainfall will have tracts that receive large amounts of rain, and areas of great rainfall may have places with little rainfall or especially large amounts of rainfall. An example is the area of scant rain in northwestern Hubei where annual rainfall amounts to between 1,400 and 1,600 millimeters in the southern part of Dashennongjia and the eastern part of Guangding Shan in Zhuqi County. Meanwhile, in high rainfall areas of the Chang Jiang and the valleys of the Qing Jiang and the valleys of the Qing Jiang the quantity of rainfall is by no means great. However, in the southern part of Wufeng County in southwestern Hubei, in the western and southern part of Hefeng County, in northern Jianshi County, and near the Jiugong Shan in Tongshan County in southeastern Hubei, annual rainfall reaches 1,800-2,200 millimeters.

Since atmospheric circulation differs from year to year, marked changes occur in the amount of precipitation in Hubei Province from one year to another. Looked at in terms of the assured amount of precipitation,[1] through more than 1,200 millimeters of precipitation fall in 8 or 9 out of 10 years in southeastern and southwestern Hubei, more than 1,000 millimeters fall along the Chang Jiang in eastern Hubei, more than 900 millimeters fall on the Jianghan Plain, more than 700 millimeters fall on the southern and northern sides of the Dahong Shan, and more than 900 millimeters fall in the northwest mountain region of Hubei. Nevertheless, there is a great disparity between years of maximum and minimum precipitation. On the Jianghan Plain, precipitation during years of maximum rainfall is between 1.8 and 2.2 times greater than during years of minimum rainfall. In Enshi, the difference is least being less than 1 time greater. In other areas it runs between 1.2 and 1.6 times. This shows that all locations can experience years of great drought or years of great waterlogging, particularly on the Jianghan Plain.

2. Seasonal Distribution and Variation in Precipitation

Annual distribution of precipitation within the province varies both in time and place. Precipitation is greatest in summer when the southern part of the Jianghan Plain and southeastern Hubei receive slightly less than 40 percent of their total precipitation while other areas get more than 40 percent of theirs. During winter, precipitation is slight, slightly more than 10 percent of the year's total falling in southeastern Hubei, between 5 and 6 percent falling in northwestern Hubei, and between 7 and 9 percent falling in other parts of the province. Comparison of precipitation for the spring and autumn seasons shows that, except for northwestern Hubei where slightly less rain falls in spring than in autumn, elsewhere spring rainfall is greater than autumn rainfall. Spring season precipitation amounts to between 25 and 30 percent of the annual total to the west of a line running from Dawu, Zhongxiang, and Yidu. South of a line running from Huangmei, Echeng, Mianyang, and Shishou, 35 percent of annual precipitation falls in spring. Other areas get between 30 and 35 percent of their precipitation in spring, and this includes the Jianghan Plain and parts of southeastern Hubei Province

1. Assured amount of precipitation means the degree of certainty that precipitation will reach a given level.

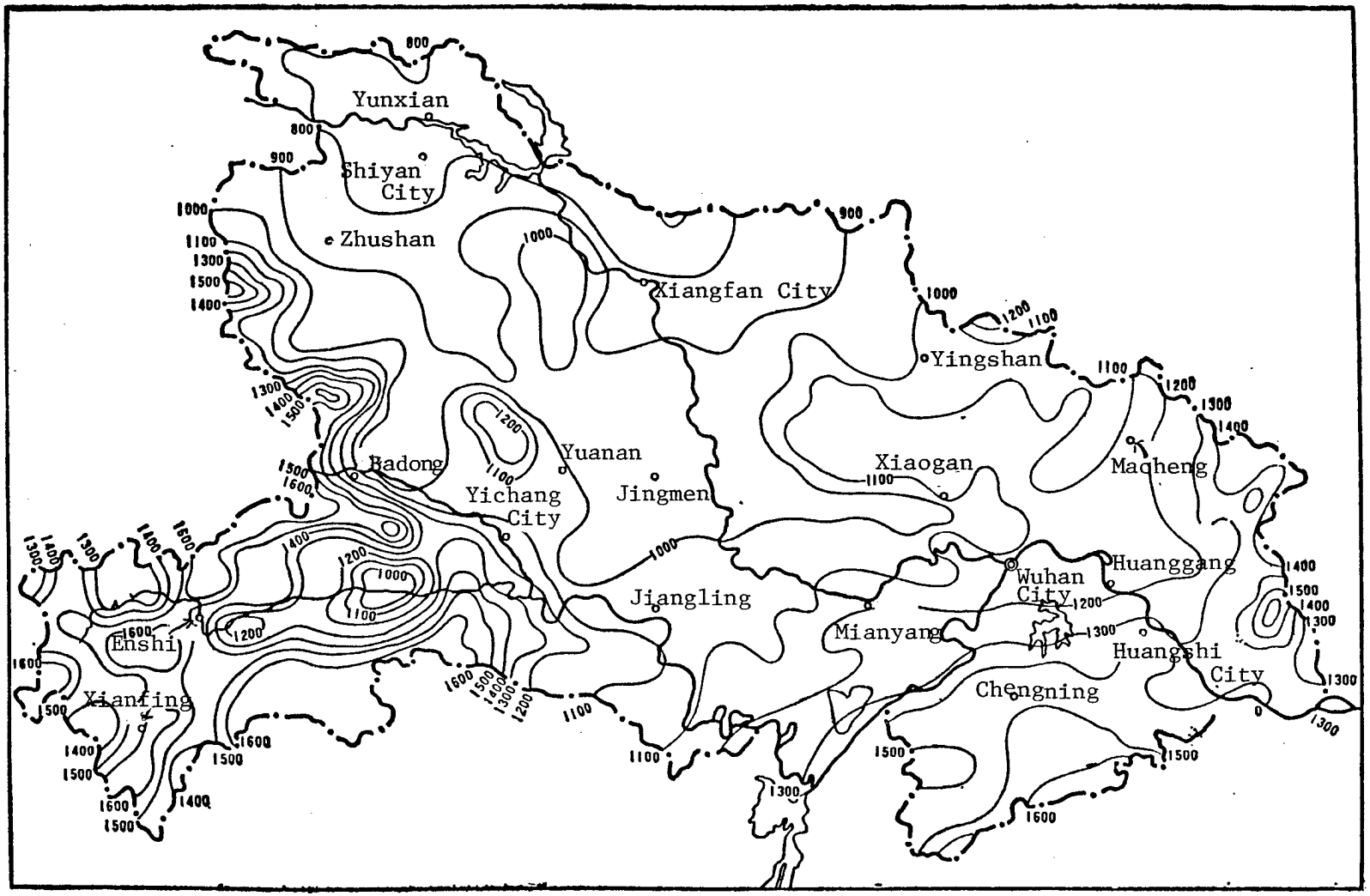

Figure 5. Map Showing Annual Amount and Distribution of Precipitation in Hubei Province

where more rain falls during spring than summer. Autumn precipitation is less than 15 percent of the annual total in eastern Hubei, more than 26 percent in northwestern Hubei, and between 15 and 25 percent elsewhere. It should be especially noted that the period between April and October is when all kinds of farm crops in Hubei Province are at the height of growth, and it is during this period that about 80 percent of the total annual precipitation falls. This is also the period of warmth, which provides extremely favorable conditions for agricultural production.

Precipitation differs from place to place each year in Hubei Province. Not only is precipitation scant during the winter season, but variation is fairly great (see Table 1-4). When rainfall tends to be great, waterlogging can cause damage; when it tends to be too little, winter drought may ensue. Seasonal variation in the amount of rainfall is least during spring. Except for northern Hubei where slightly more than 40 percent of the annual total falls, elsewhere slightly less than 37 percent falls. It is spring when the grain of overwintering crops forms, and late March and April is the time for spring sowing of crops and the seedling stage. Too much rainfall during this time is an important reason for the rotting of early rice seedlings, and frequently dryland crops may also be damaged. Waterlogging produces an increase in diseases and insect pests of wheat, and causes cotton seeds to rot and seedlings to die. Such situations frequently occur in eastern Hubei and on the Jianghan Plain. Except in the western mountains and the northern hills summer rainfall in Hubei Province varies by more than 50 percent. Frequently summer precipitation comes in torrential rains when large quantities of rain fall with great force giving rise to mountain floods and waterlogging. At the same time, long periods of little or no rain may occur causing drought. Variation in the amount of autumn precipitation is fairly great, so frequently autumn drought occurs. Sometimes drought is continuous during summer and autumn. In some years, the weather is continuously overcast and rainy during autumn. The probability of this happening is as follows: In eastern Hubei, it will happen an average of 2 or 3 years out of 10; on the Jianghan Plain, it will occur 3 or 4 years out of 10. Continuously overcast and rainy weather over a long period of time in autumn will cause cotton bolls to rot and interfere with the on-time autumn sowing.

2. Calamitous Weather and Safeguards Against It

In Hubei Province, climatological conditions of light, heat and water are superior to most places; nevertheless drought, torrential rains, autumn cold and the return of cold in spring causes damage to agricultural production.

(1) Drought

Drought is the province's most common natural calamity. It can occur in any of the four seasons, and it is only the frequency of its occurrence and how long it lasts that determines the different extent to which agricultural production will be hurt. Statistics show that in Hubei Province summer drought is most common, winter drought fairly common, and autumn drought more common than spring drought. In addition, sometimes there is continuous summer and autumn drought. Summer drought usually occurs at the height of summer

Table 1-4 Amount of and Variation in Precipitation for January, April, July and October From Representative Stations

(a) 站名 \ (b) 降水量和降水变率	(c) 1月		(d) 4月		(e) 7月		(f) 10月	
	降水量 (g) (毫米)	平均相对变率% (h)	降水量 (g) (毫米)	平均相对变率% (h)	降水量 (g) (毫米)	平均相对变率% (h)	降水量 (g) (毫米)	平均相对变率% (h)
Yingshan	31.4	52	152.8	30	222.5	49	61.0	80
Xinzhou	28.8	50	143.5	34	175.2	50	62.1	75
Huanggang	39.6	44	145.6	30	137.8	69	55.2	70
Chongyang	46.7	38	190.4	32	128.4	51	67.1	53
Xianning	50.4	42	175.4	28	137.4	54	77.4	49
Enshi	26.2	50	113.8	34	104.3	48	113.2	82
Lichuan	17.9	45	100.8	25	164.4	46	106.4	31
Lucongpo	25.4	40	158.8	21	263.9	42	157.4	34
Wufeng	24.8	47	133.5	36	228.0	60	98.4	45
Yichang	22.8	60	102.0	30	217.2	47	77.2	53
Jiangling	30.2	57	123.2	37	157.2	58	75.7	60
Lanli	34.4	47	157.3	27	109.5	63	82.3	58
Hankou	36.6	49	140.3	33	167.1	66	61.1	61
Xiaogan	30.8	49	133.8	80	183.6	62	60.3	64
Yingshan	20.9	61	101.3	48	210.9	51	52.9	47
Zhongxiang	25.7	64	79.0	54	169.4	51	53.3	58
Xiangyang	20.4	69	81.7	43	143.0	43	60.0	47
Yunxian	15.6	64	81.7	41	132.7	39	64.5	48
Fangxian	8.8	58	76.9	32	144.9	36	64.2	39

Key:
a. Station name
b. Amount and variation in precipitation
c. January
d. April
e. July
f. October
g. Amount of precipitation (millimeters)
h. Average relative variation (percent)

following the plum rains, and is commonly termed dog days drought. Dog days drought occurs most commonly on the Jianghan Plain and in eastern Hubei. In 8 or 9 out of 10 years, drought occurs for less than a month. In about 3 out of 5 years, drought occurs for more than a month. In the southwestern mountains of Hubei during July, precipitation is greatest there during July and August, and summer drought is cut short by the rainy season. Thus, drought there commonly occurs in early or late summer; however, long periods of major drought are fairly rare. In eastern Hubei and on the Jianghan Plain, autumn drought occurs with fair frequency on an average of four to five times each 10 years. Meanwhile, autumn drought is fairly rare in western Hubei

where rain falls continuously, occurring only two or three times every 10 years. In some cases, autumn drought follows a continuous summer and autumn drought or after summer drought has moderated. This happens fairly frequently on the Jianghan Plain and in central Hubei on an average of once every 3 years. Second in frequency is northwestern Hubei and northern Hubei where it occurs about once every 4 or 5 years. It happens least in the mountain regions of southwestern Hubei, approximately once every 8 or 9 years. In spring, precipitation increases markedly and with little variation. Cases of spring drought lasting more than 40 days occur once every 4 years or so in northern and northwestern Hubei, once every 10 years on the Jianghan Plain, and rarely elsewhere. Winter drought also occurs frequently in Hubei Province, and covers wide areas. Such droughts occur on an average of once every 3 or 4 years. Since the founding of the People's Republic, three serious winter droughts have occurred and lasted about 100 days each.

Drought causes very serious damage to agricultural production in the province. During the last of the three periods of the hot season, temperatures are high, evaporation is rapid, and crop requirements for water are most pressing on the Jianghan Plain, and in central and eastern Hubei. Lack of a soaking rain for 10 days to 2 weeks means the beginning of drought. If a serious drought occurs, transplanting of late rice crop seedlings will be delayed and cotton buds and bolls will drop. In the mountains, summer drought frequently results in reduced corn yields. The masses call this a "neck wrenching drought." Because of the protracted period of continuous summer and autumn drought, and the wide area covered, crops are affected most adversely. There have been four continuous summer and autumn droughts covering wide areas in Hubei Province since the founding of the People's Republic, in 1959, 1966, 1972 and 1978. The drought of 1978, in particular, meant scant plum rains in early summer, the early advent of the height of summer, a long period of stifling heat, and strong winds from the South China Sea for a summer such as has rarely occurred in history. This particularly great drought year of continuous summer and autumn drought occasioned huge damage for agricultural production. In addition, serious winter droughts such as those of 1955 and 1956, and the continuous autumn and winter drought of 1973 also seriously hurt quality of winter sowing, and occasioned severe shortages of seedlings, gaps in rows where crops failed to grow, and dead seedlings.

(2) Torrential Rains, Flooding and Waterlogging

Torrential rains (with downpours of more than 50 millimeters per day) frequently occur in Hubei Province during late spring and summer, and in some years great torrential rains (with downpours of more than 100 millimeters per day) or extremely great torrential rains (with downpours of more than 200 millimeters per day) occur. Statistics on daily torrential rains for the period May to August 1959-1975 showed greatest rainfall on the north side of Mufu Shan and the south side of Dabie Shan, with rainfall averaging more than 50 days. This included 68 days of rainfall at Puche, and 71 days of rainfall at Dawuda. In the Mufu mountain region, most rainfall comes during May and June, two-thirds of the total annual rainfall occurring at that time. In the Dabie mountain region, it comes mostly during July when two-fifths of the total amount falls. In southwestern Hubei, it rains for about 50 days, mostly

during June and July with Hefeng getting the maximum amount, as much as 63 days of rainfall. The Jianghan Plain gets about 40 days of rainfall and southwestern Hubei less than 20 days during this period.

Using a daily rainfall of more than 100 millimeters, or 150 millimeters over a period of 3 days, as a standard for the occurrence of floods and water-logging, some parts of Hubei Province are flooded or waterlogged virtually every year. Since the founding of the People's Republic, fairly large-scale flooding and water-logging occurred in 1953, 1954, 1955, 1958, 1963, 1964, 1969 and 1970. The flooding and waterlogging of 1954, 1964 and 1969 covered most of the province. In other years, flooding and waterlogging occurred mostly on the Jianghan Plain and in eastern Hubei. Flooding and waterlogging on a large scale in Hubei Province occurs mostly during June and July at the time of the plum rains, and is caused by the continuous torrential rains that fall during this period. This was most apparent in 1954, 1955, 1964 and 1969. In 1954, for example, the plum rain period lasted 53 days. Hankou had more than 900 millimeters of rainfall, 80 percent of it torrential rains, which caused some of the greatest flooding that has occurred during the past 100 years. Though the period of the plum rains was short in 1964 and 1969, the volume of rainfall was highly concentrated. In 1964, more than 300 millimeters of rain fell in 20 counties and cities in an 8-day period, 8 of these counties and cities getting between 500 and 800 millimeters. In 1969, 25 counties and cities got 500-850 millimeters of rain in 16 days. As a result, torrents of water rushed down mountains, and the plains became sodden to the point of disaster. Flooding and waterlogging occurred particularly in Huanggang, Xianning, Xiaogan and the southern part of Jingzhou prefectures, on an average of once every 3 years. In western and northern Hubei where there are few hills, flooding and waterlogging occurred on an average of once every 5 to 8 years. The situation changed from one year to another, but sometimes flooding and waterlogging occurred year after year. Furthermore, in some years both droughts and waterlogging occurred, usually waterlogging preceding drought.

(3) Autumn Cold

Following the advent of autumn, cold northern air again invades the south, and under the influence of cold air, Hubei Province's average daily temperatures fall to below 20°C for more than 3 days at a stretch. Such low temperatures around the time of the autumnal equinox are also termed autumn cold. Autumn cold hurts normal booting and flowering of double cropped rice, and increases the empty glume rate causing reduced yields or even an aborted harvest. Survey data shows that when autumn cold occurs at this time, the empty glume rate for double cropped late rice reaches 30 to 40 percent, and the longer it lasts or the lower the temperature goes, the more serious the damage. The reason autumn cold so readily causes damage during the heading and flowering stage is that low temperatures inhibit the pollen's normal development and metabolism, causing abnormal metabolism of matter. Though such damaged pollen grains can complete the germination and fertilization process, following fertilization, the grain can develop no further, and empty glumes or blighted grain results.

The earliest period of occurrence of autumn cold is early September in western mountain regions and in northern Hubei. In other areas, it comes around 10 September. Cold does not occur in September in western mountain regions or the northern part of the province in 1 or 2 years out of 10, and the same is true in 3 to 5 years out of 10 in the eastern parts of the province. In 8 out of 10 years when autumn cold does not occur at the dividing line period, it occurs before 15 September in the western mountains of Hubei, before 20 September in northern Hubei and around the Dahong Shan as well as in southern Jingzhou Prefecture, between 25 and 27 September in eastern Hubei, and around 23 September in central Hubei. The safe full heading period for double cropped rice in Hubei Province is before 25 September in the east, before 15 September in the western mountain regions, and around 20 September elsewhere.

(4) Spring Low Temperatures and Rainy, Overcast Weather

Hubei Province sits astride the area where cold and warm air currents intermingle in spring. Cold air frequently enters the area, and dramatic changes in the weather occur. Statistics show the incursion of intensely cold air once every 7 to 10 days, and during the several days when intensely cold air invades, not only do temperatures decline markedly, but sometimes snow flurries and frost appear to the accompaniment of continuously rainy and overcast weather, which sometimes lasts for a long time.

Spring weather during the sowing season may be classified in terms of the combined affect on spring sowing and production of spring temperatures, sunshiny days and precipitation conditions as a warm spring, a generally normal spring, or a cold spring. Warm springs are years when the sky is clear and the air warm, favoring growth of full stands of sturdy seedlings. Such springs occur on an average of three or four times every 10 years. Generally normal springs are springs that are a mixture of warm springs and cold springs; they occur two or three times every 10 years. Cold springs have a lot of cold air activity with numerous rainy or overcast days; air temperature rises only slowly and tends to be lower than in ordinary years. Frequently air temperatures do not get any warmer than 12°C until after Qingming around 5 April or even after 10 April. Early on temperatures continue fairly high only to continue fairly low later on, or else intensely cold air termed the "return of cold in spring" invades during early or mid-April. In Hubei Province, cold springs or the return of cold in spring happens on an average of three or four times every 10 years. During the 1960's, this kind of weather occurred most frequently, cold springs or the return of cold in spring taking place in 1960, 1963, 1964, 1965, 1966 and 1969.

Low temperatures and continuously overcast and rainy weather in spring does very great harm to the province's agricultural production. Frequently such weather causes the rotting of early rice seedlings, the rotting of cotton seeds or the death of cotton seedlings, and varying degrees of freeze damage to crops that are to be harvested in summer such as wheat, rape and broad beans.

In addition, hail and tornadoes cause extremely great damage to farm production in some parts of the province that cannot be ignored.

Since the founding of the People's Republic, the people of Hubei Province have taken effective actions of various kinds to surmount calamitous weather, scoring huge successes thereby and accumulating quite a few experiences. Still further understanding and mastery of changes in weather patterns is necessary, and vigorous efforts must be made in capital construction of farmlands centering around soil improvement and harnessing of water, with energetic afforestation, intensification of water and soil conservation, rational arrangement of crop patterns, matching of crops varieties, producing man-made rain, and eliminating hail so as to reduce to the minimum the harm that weather does to farm crops.

Third Section. Land Resources and Soil Resources

1. Land Resources

Hubei Province covers an area of 281.1 million mu (187,400 square kilometers) accounting for about 1.95 percent of the country's total land area. In 1978, 151.83 million mu or 54 percent of the total land area was used for agriculture. This included 20.4 percent used for farming, 31.9 percent used for forestry and 1.7 percent used for raising aquatic products. An additional 11.3 percent of the province's total land area consists of barren mountains or wasteland, plus quite a large amount of unused water surfaces (see Table 1-5)。 Very clearly a considerable potential still exists in land resources.

Table 1-5 Utilization of Hubei's Land Resources (1978)

Kind of land	Land area (10,000 mu)	Proportion of total area (percent)
Total area	28,110.00	100.00
1. Already in use for agriculture	15,183.00	54.00
(1) Cultivated land	5,735	20.4
(2) Forestland	8,975.00	31.9
(3) Water surfaces for rearing aquatic products	473	1.7
2. Waste farmland	3,186.00	11.3
3. Unused water surfaces	2,000	7.1
4. Other	7,741	27.6

(1) Cultivated Land

Statistics showed a cultivated land area of 56.52 million mu for the province in 1978. This included 29.39 million mu of wetlands, or 52 percent of the total cultivated area, and 27.13 million mu of drylands (including more than 3 million mu of irrigated fields), or 48 percent of the total cultivated area. The cultivated area was divided roughly equally between wetlands and drylands. This distribution and method of utilization were as follows:

1. Much Cultivated Plains and Hills With a High Reclamation and Cultivation Index

The Jianghan Plain and the hills of northern Hubei are the places in which most of the province's cultivated land is concentrated and the place where the reclamation and cultivation index is highest. Though only 43 percent of

the province's total land area, 64 percent of all its cultivated land is located here.

In terms of topographic conditions, the land reclamation and cultivation index may be divided into three grades as follows:

First grade, with a reclamation index between 40 and 60 percent. Mostly the Jianghan Plain and the hills of northern Hubei make up this first grade. Some of the plains lake area counties in the middle of the Jianghan Plain have a reclamation and cultivation index of between 50 and 60 percent. In Mianyang, Jiangling, and Hanchuan counties, the reclamation and cultivation index approaches about 60 percent. In transitional counties between the plain lake area to the surrounding low hill region, and in all the counties in the hills of northern Hubei, the reclamation and cultivation index is between 40 and 50 percent. Within this area, the more gradual the slope of the hills and the larger the tracts of flatlands, the higher the reclamation and cultivation index. In counties such as Xinzhou and Zhijiang, for example, the reclamation and cultivation index approaches 50 percent.

Second grade, with a reclamation and cultivation index between 20 and 40 percent. Counties belonging to this grade are located mostly in the low mountain and hill areas of eastern Hubei, and along the fringes of the mountainlands in western Hubei. These are hill lands, for the most part, in which the terrain slopes gently as in Huangpo, Xiaogan, Huangmei, and Guangji Counties where the reclamation and cultivation index is between 30 and 40 percent. In counties such as Yingshan and Dawu, with many ups and downs in the terrain, the reclamation and cultivation index approaches 20 percent.

The third grade has a reclamation and cultivation index between 10 and 20 percent. Counties in this grade are concentrated in the province's western mountains where the terrain rises and falls greatly, with small amounts of cultivated land in basins among the mountains and on high plateaus. Thus, the reclamation and cultivation index is low.

2. Concentration of Wetlands on the Jianghan Plain and in Eastern Hubei, With a High Multiple Cropping Index

In Hubei Province, most of the wetlands are on the Jianghan Plain, in the province's central hills in northeastern Hubei, and in southeastern Hubei covering an area of more than 25 million mu, and accounting for 85 percent of all wetlands in the province. Drylands are located mostly along the Chang Jiang, the Hanshui and in the river silt belts on both shores of their tributaries as well as in the hills of northern Hubei. These dryland areas account for more than three-fifths of drylands in the province as a whole. The remainder are located in the western mountains of Hubei and in the low mountain and hill regions of eastern Hubei, the dryland area of Enshi Prefecture being the largest of these.

Cultivated land multiple cropping indices vary markedly from place to place, but are generally high in the east and low in the west. In eastern prefectures of Hubei Province, where population is large relative to cultivated land, the

multiple cropping index is highest. In recent years it has generally been between 190 and 220 percent. In Yunyang and Enshi Prefectures in the western mountain region of Hubei, the multiple cropping index is lowest, generally being between 150 and 160 percent. In recent years, as a result of major efforts to restructure the farming system in the provinces' western mountain regions, the multiple cropping index has risen markedly. In Yunyang Prefecture, for example, the multiple cropping index rose from 150 percent in 1975 to 166 percent in 1977, and in Enshi Prefecture, it rose from 159 percent in 1975 to 172 percent in 1977.

3. Much Land Suitable for Machine Cultivation on Plains and Hills; Ratio of Mountain Slopes Large

In 1977, statistics showed 32.95 million mu, or about 58 percent of the province's total cultivated area suitable for machine cultivation. Most of the land suited for machine cultivation is concentrated on the plains and in the hills. More than 80 percent of the land suitable for machine cultivation is here. Very little land in the vast mountain regions is suited to machine cultivation. In the province's western mountain regions, machine farmable land currently amounts to only 8.5 percent of the land suited for machine cultivation in the province as a whole. This is mostly because of the numerous slopes and small plots of land. Statistics show more than 60 percent of total cultivated land in Yunyang Prefecture to be slopes, and that most of the wetlands are some of the drylands are small plots. Thus only through energetic terracing of slopes and turning small fields into large ones will it be possible to change the land's unsuitability for machine cultivation.

(2) Forestlands

As of 1975, Hubei Province had 89.75 million mu of forests of which 50,617,000 mu were timber forests (including 39,177,000 mu of natural forests and 11,436,000 mu of man-made forests) accounting for 56.4 percent of the total forest area. It had 7.78 million mu of economic forests (including grain from perennial crops, wood oil and wood fungus forests, and tea oil forests) accounting for 8.6 percent of the total, and firewood forests, shelter forests, and special purpose forests accounting for 8.1 percent of the forested area. In addition, it had 16,363,000 mu of scrubland (18.7 percent), 5,158,000 mu of sparse woodlands (5.7 percent), and 2.77 million mu of sapling forests (3 percent). These last named kinds of woodlands are the ones requiring transformation and improvement.

Forestland distribution has two distinguishing characteristics as follows:

1. Natural forests are distributed mostly in the western mountain regions of the province, while man-made forests are concentrated principally in low mountain and hill regions.

Sixty-three percent of the province's natural forestlands (more than 24.8 million mu) are located in the province's western mountain regions. The remainder is scattered over a farflung low mountain and hill region including the Dabie Shan and the Tongbo Shan in northeastern Hubei, the Mufu Shan in

in southeastern Hubei, and in the Dahong Shan in central Hubei. More than 60 percent of the man-made forests are located in the low mountain hill regions of Huanggang, Xianning, Xiaogan, Xiangyang, and Jingzhou Prefectures. Only about 27 percent of them are located in the province's western mountains.

2. Economic forests are concentrated largely in the province's western mountain regions.

Economic forests cover an area of about 4.35 million mu in the western mountain regions of the province, and account for 55.8 percent of the province's total economic forests. Most of the province's wood fungus forests (sawtooth oak) [Quercus acutissima], tung tree [Aleurites fordii] forests, walnut tree [Juglans regia] forests, and tussah oak [Quercus mongolica] forests grow here. Economic forests in the province's southwestern mountain regions cover 1.3 million mu or 16.7 percent of the province's total forested area. Here the famed raw lacquer trees, Chinese tallow trees, Chinese gallnut trees, citrus fruit trees, and tea shrubs are grown. An additional more than 2.4 mu of economic forests are located in the province's eastern hill region, and consist mostly of Chinese tallow trees, Chinese chestnut trees and tea oil trees.

(3) Water Surfaces for the Breeding of Aquatic Products

As of 1975, the province had more than 4.03 million mu of water surfaces used for the breeding of aquatic products. Lakes accounted for 38.7 percent of this total, dammed ponds and reservoirs for about 30 percent, and river ports for only 1.4 percent. Mostly lakes and shallow water areas were used as water surfaces for the breeding of aquatic products, little being done in other waters.

The province's water surfaces used for breeding are concentrated in Jingzhou, Huanggang, Xiaogan, and Xianning Prefectures, and in Wuhan. (see Table 1-6) A substantial water surface area usable for the breeding of aquatic products also exists in Suixian and Zaoyang Counties in Xiangyang Prefecture, in Junxian and Yunxian Counties in Yunyang Prefecture, and in Shiyan city. These are also the places in which a fairly great potential exists for the breeding of aquatic products.

(4) Wastelands and as Yet Unused Water Surfaces

The province currently has a total of 31.86 million mu of barren mountains and wasteland, including 31,250,500 mu of barren hills and wasteland in the central hill region, and 317,900 mu of sandy wasteland along rivers. In addition, it has 292,000 mu of land on which timber has been felled or destroyed by fire. The vast wastelands in mountains and hills are the province's major land resources awaiting development. These lands are distributed throughout the entire province, but are concentrated largely in the following four regions:

1. The Western Hubei Mountainlands. Here lie about 20 million mu of barren mountains and wastelands including 78.37 million mu in Yunyang Prefecture, 7.13 million mu in Enshi Prefecture, and 41.67 million mu in Yichang Prefecture. Ten counties (Yunxian, Yunxi, Hefeng, Lichuan, Xuanen, Enshi, Fangxian,

Table 1-6 Statistical Table on Main Prefectures Using Water Surfaces for Breeding of Aquatic Products in Hubei Province (1975)

Units: 10,000 mu

(a) 地区(市)名	(g) 养殖总水面	占全省比重(h)(%)	(i) 其中湖泊	占本区比重(j)(%)	(k) 塘堰	占本区比重(j)(%)	(l) 水库	占本区比重(j)(%)
荆(b)州	100.02	25.7	55.36	35.4	23.6	19.5	21.06	17.5
黄(c)冈	61.6	15.2	17.54	11.2	21.12	17.5	22.87	19.0
孝(d)感	78.96	19.6	27.79	17.8	32.95	27.3	16.54	13.7
咸(e)宁	56.62	14.0	32.97	21.1	13.53	11.2	9.77	8.1
(f)武汉(市)	15.35	3.8	11.67	7.5	3.66	3.0	0.02	0.01

(m) 现属武汉市的武昌县养殖面积5.5万亩，汉阳县养殖面积11.5万亩，当时分别统计在咸宁、孝感两地区养殖水面之中。

Key:
a. Prefecture (or city)
b. Jingzhou
c. Huanggang
d. Xiaogan
e. Xianning
f. Wuhan City
g. Total water surface breeding area
h. Percent of province total (percent)
i. Lakes
j. Percent of prefecture total (percent)
k. Dammed ponds
l. Reservoirs
m. Wuchang County, which is now part of Wuhan City as a 55,000 mu aquatic products breeding area; and Hanyang County has 115,000 mu. In 1975, statistics for these places were included in those for Xianning and Xiaogan Prefectures.

Zhushan, Junxian and Badong Counties) containing more than 1 million mu of barren mountains are located in these prefectures. Survey shows that about 10 percent can be gradually turned into farmland, and that the remaining 90 percent should be used for development of timber forests, economic forests, and the livestock industry, the building of timber forest bases being paramount. In addition, where conditions permit, pastures grasses should be sown to establish animal husbandry bases primarily for the raising of cattle, sheep and goats.

2. The Central Hubei Hill Region. An estimated more than 3 million mu of barren mountains and wasteland lies in this region. This is about one-tenth of the province's total barren mountain and wasteland area. Mostly it lies in an area stretching through Jingmen, Zhongxiang, Suixian and Yingshan. In this area, the barren mountains and wastelands slope gently, and the soil is fertile. About one-fourth of it can be developed as farmland, and more than one-half of it can be devoted to forestry and special products. The remainder can be used as pastureland for development of animal husbandry bases primarily for the raising of cattle.

3. The Mufu Shan Low Mountain and Hill Region. Here lie probably somewhat more than 2 million mu of wasteland. Future development should be for agriculture, forestry and animal husbandry, with emphasis on the growing of bamboo, Chinese fir, fiber crops (ramie), tea and mulberry.

4. The Dabie Shan Low Mountain and Low Hill Region. About 2 million mu of wasteland is located in this region. Soil erosion is serious here, and future land utilization should stress development of economic forests and timber forests. At the same time, both farming and animal husbandry should be developed.

A forestry survey conducted in 1975 shows about 70 percent of the province's barren mountains and wastelands to be concentrated in tracts. An example is a more than 10,000 mu tract of barren mountains and an almost 6 million mu tract of wasteland in Yunyang Prefecture, which are suitable for the building of large scale bases for forestry, special products and animal husbandry.

In addition to the 4,035,000 mu of water surfaces in the province that are already being used for the breeding of aquatic products, there is another more than 5.8 million mu water surface area in the province's rivers, most of which is currently used for fishing. Yet another more than 3 million mu of water surfaces suitable for the breeding of aquatic products has yet to be used for this purpose. This includes a 2.07 million mu lake area, a 1.02 million mu reservoir area, a 400,000 mu dammed pond area, and a 180,000 mu river port area. Were these resources to be put to use, the province's water surface area used for the breeding of aquatic products would reach 7 million mu.

2. Soil Resources

Soil is the foundation of agricultural production. People long ago realized that, "It is from the soil that all things grow," and "Where there is soil, there is food."

In Hubei Province, the natural geography and the biological and meteorological conditions that have produced soil are complex, and the topography has changed greatly. The mother material from which soil has been made is of diverse kinds. There is the ancient metamorphic rock of the Dabie Shan region, the vast area of limestone of the Wuling Shan region, the granite and the sandstone of the Mufu Shan region, and the gneiss and Quarternary Period brown clay of eastern Hubei. There are also broad reaches of river sediment from recent times. Thus, Hubei Province has numerous varieties of soil, and soils ranging from the sandy to the clayey are distributed over a fairly large area. The cultivated land is divided about equally between wetland and dryland, and exhibits features of a transitional area between south and north.

One such feature is the moderate degree of alkalinity or acidity (pH) of the soil. A soil's pH is of primary importance in the growing of crops. Numerous farm crops, forest trees and pasture grasses are suited to growth in soil with a pH of between 6 and 8. Plants do not grow well in soils that are either overly alkaline or overly acidic (acid loving and alkaline loving plants aside).

Such soils do not favor plant absorption of nutrients from the soil. Because of the moderate precipitation and heat conditions in Hubei Province, a balance is maintained between the amount of asalts that leach out of and accumulate in the soil; consequently, the strongly acidic (below pH 5.5) red and yellow soils of the south are extremely rare in Hubei, and there is even less of the strongly alkaline (above pH 8.5) soil found in north China. In Hubei Province, 45 percent of the soil is mildly acidic (a pH value of from 5.5-6.5), 33 percent is neutral (a pH value of 6.5-7.0), and 21 percent is mildly alkaline (pH value of 7.0-8.0). These values favor the growing of all kinds of crops and provide extremely favorable conditions for development of farming, forestry and animal husbandry production in Hubei Province.

A second such feature is the soil's organic content. Organic matter in the soil is one of the most important integral parts in the comparative activeness of soil. A soil's organic content directly affects its physical, chemical and biological properties. To a very great extent of a soil's granular structure and tilth, as well as its ability to conserve water and fertilizer, to stabilize temperature and moisture are determined by its organic matter. Numerous plant nutrients such as nitrogen, sulfur, phosphorus, boron, and molybdenum derive largely from the soil's organic matter. A soil's organic matter plays many roles, such as improving soil porosity and increasing the activity of micro-organisms in the soil. Therefore, a soil's organic matter must be a primary indicator of soil fertility. All of the soils in Hubei Province that produce consistently high yields, such as oily sandy soil [3111 3097 0960], oily yellow soil [3111 7806 0960], and oily baishan soil [3111 4101 0960/0810 0960] and oily magan soil [3111 7456 5139 0960] have an organic content of around between 1.5 and 2 percent. On the other hand, all the soils that produce low yields such as liaojiang loess [2436 1203 7806 0960], dead loess, and windblown sand have an organic content of less than 1 percent. In 1957, when the first soil survey was done in Hubei Province, about 83 percent of all the cultivated land had an organic content of less than 1 percent or between 1 and 2 percent. Measurements made in recent years in Xiangyang Prefecture and in Xinzhou and Echeng Counties shows a further general trend toward decline in soil organic content; only in individual places has there been a slight increase. In Xishui and Mianyang Prefectures, the masses report that the soil has become increasingly stiff and leathery. This condition is closely related to the soil's inadequate organic content. Thus, the inadequate organic content of the soil is a conspicuous problem in the development of farming, forestry and animal husbandry in Hubei Province. This problem requires vigorous action to raise the soil's organic content to a general 2 to 3 percent as quickly as possible. The main way in which to increase the soil's organic matter and maintain or increase the dynamic balance of the soil is rational crop rotation, an increase in the growing of pulse crops and pulse green manure, and more manuring. (Hubei Province's principal soil types, their pH, and their organic content are shown in Table 1-7.)

Hubei Province's soil may be roughly divided into four main types, namely, lake region, hill region, rolling hill region and mountain region soil.

Table 1-7 Major Soil Types, pH, and Organic Content

(a) 土壤类型	(i) 耕地面积 (万亩)	(j) 占全省耕地 %	(k) PH 值范围	(l) 土壤有机质含量 %	(m) 主要分布地区
(b) 平原湖区冲积土	1,772	30.9	6.5—8.5	1.3395—2.140	江汉平原 (n)
(c) 丘陵黄土	1,700	29.6	6.2—7.0		鄂中丘陵 (o)
(d) 岗地黄土	415	7.2	6.7—7.2	1.0168—1.2492	鄂北岗地 (p)
(e) 山地黄土	458	9.1	6.0—6.6	1.8—2.2	山区 (q)
(f) 灰色土	119	1.2	5.0—6.8	2.0—3.9	山区 "
(g) 沙泥土	350	6.1	5.7—7.3	1.3572—1.8028	鄂东 (r)
(h) 红黄土	286	4.9	4.5—6.6	1.0688—2.094	鄂南 (s)

Key:
a. Soil type
b. Plains lacustrine alluvium
c. Hill region loess
d. Upland loess
e. Mountain region yellow soil
f. Ashen gray soil
g. Sandy loam
h. Reddish yellow soil
i. Cultivated land area (10,000 mu)
j. Percent of total cultivated land in province
k. pH range
l. Soil's organic content (percent)
m. Major areas of distribution
n. Jianghan Plain
o. Central Hubei hill region
p. Northern Hubei upland
q. Mountain regions
r. Eastern Hubei
s. Southern Hubei

(1) Plains Lake Region Soil

Plains lake region soil consists mostly of alluvium, lacustrine sediment secondarily.

The alluvium is distributed largely on the Jianghan Plain and in the alluvial plains areas in the valleys of tributaries to the Chang Jiang and the Hanshui. It is the most widespread of all the province's soils covering an area of about 19 million mu, or about one-third the province's total cultivated land area.

The Jianghan Plain has been formed by sediment from repeated flooding of the Chang Jiang and the Hanshui. Its soil is thick and fertile. As a result of the separation occasioned by the current, the size of granules of river sediment and the proportions of silt are distributed in a pattern. In places near the river beds or in the main path of flooding, the sediment is fairly coarse. Farther away from the river beds or in the main flood path, the sediment is comparatively fine. Thus, in the area of the Jianghan Plain from the river bed to the hills, soil quality ranges from coarse gravel to fine silt. In terms of soil type, it is distributed in a pattern that ranges from river silt to oily sand to normal soil to yellow soil [7806 0960] (see Figure 6].

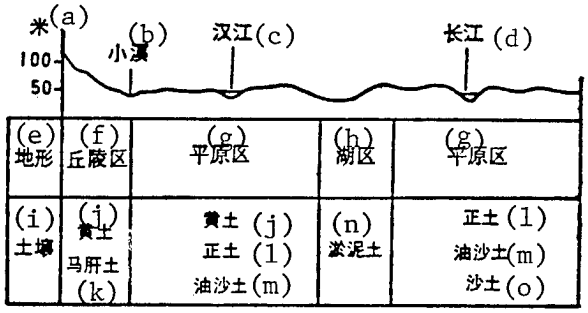

Figure 6. Sectional Drawing Showing Soil Distribution on Alluvial Plains

Key:

a. Meters
b. Creek
c. Han Jiang
d. Chang Jiang
e. Topography
f. Hill region
g. Plains region
h. Lake region
i. Soil
j. Yellow soil
k. Magan soil
1. Normal soil
m. Oily sand
n. Silt
o. Sandy soil

As a result of flooding and numerous inundations, plus differences in the amount of flooding on each occasion, within a given area there is a marked layering of alluvium by degrees of fineness to form a natural cross section of sand interspersed with clay from top to bottom. In addition, when a certain speed of flow has occurred, and since the length of flooding has differed, differences in the thickness of the alluvial layer have been produced. A layering of sand on top and clay beneath is a fairly good one because the top layer is light and porous to water and air, while the lower layer is heavy, conserving water and fertilizer. Conversely, layering in which the top layer is clay and the bottom layer is sand is poor, because the top is hard and the bottom leaking, which makes for poor porosity for air and water and for the conservation of water and fertilizer.

The alluvium mother material is of both limestone and nonlimestone types. Alluvium from the Chang Jiang and the Hanshui always produces a calcareous reaction, while most tributaries exhibit no calcareous reaction. Calcareous alluvium ranges from neutral to mildly alkaline (pH 7.4-8.0), and contains calcium carbonate. The effect of calcium carbonate on the soil's granular structure is of major significance; however, it acts to hold phosphate fertilizer. Nonlimestone alluvium shows a neutral reaction (pH 6.5-7.0).

Alluvial soil has a high natural fertility, is friable, fairly light, easily cultivated, rich in nutrients, shows quick results when fertilized, and readily grows various kinds of crops. It is one of the finest soils in the entire province.[1] Oily sandy soil and normal soil, which are found over a

1. River sandy soil (or windblown sand) are exceptions. They have been formed by sandy alluvium resulting from the flooding of rivers over the years, and are mostly found in belts along both sides of rivers on the Jianghan Plain. Since their mechanical composition is not good (their silt content too high), and since their organic and nutrient content is low, they are soils that produce low yields.

fairly wide area, have been particularly hailed as "the kings of silt," and "a treasure among soils" (see Table 1-8). These are the soils that produce the province's high yields of paddy rice, wheat, cotton and oil-bearing crops. However, in plains lake regions, it is necessary to lower the water table, to have separate drainage and irrigation systems, to control water rationally, to cover gravelly fields with a layer of soil, and to fertilize with phosphate in order to eliminate the disadvantages of alluvial soil.

Table 1-8 Physical and Chemical Structure of Oily Sandy Soil and Normal Soil

	(c) 有机质	(d) 全氮	(e) 全磷	(f) 全钾	(g) 阳离子代换量
(a)油沙土	1.3—1.8%	0.08—0.13%	0.17%	2.64%	9.3毫克当量/100克土 (h)
(b)正土	1.4—2.5%	0.166%	0.26%	2.9%	17.5毫克当量/100克土 (i)

Key:
a. Oily sandy soil
b. Normal soil
c. Organic matter
d. Complete nitrogen
e. Complete phosphate
f. Complete potash
g. Amount of positive ion exchange
h. 9.3 milligrams equivalent/100 grams of soil
i. 17.5 milligrams equivalent/100 grams of soil

Lacustrine silt is distributed largely in lowlying areas adjacent to lakes on the Jianghan Plain. Lacustrine silt forms in a stagnant water environment and is produced from deposits of lacustrine sediment. It forms a thick, fertile layer of soil. Numerous aquatic plants have rotted in it, so it has high inherent fertility and a 2.19-2.6 percent organic content, and a complete nitrogen content of 0.12-0.16 percent. Lacustrine silt is the major soil resource in Hubei Province. With the building of a network of streams in lake regions, it will become fine grain bases for development of grain production. But lacustrine silt soil is heavy (80-90 percent clay, and 10-20 percent sand). It does not ventilate well, and its organic material decomposes slowly. It is low in quick acting nutrients (containing 3-8 jin per mu of quick acting nitrogen, 3.8-7.5 jin per mu of quick-acting phosphorus, and 1-20 jin per mu of quick-acting potash). In recent years, the Provincial Academy of Agricultural Sciences, the Jiangbei Farm, and Mianyang and Jianli have discovered that lake region paddy soil has a low quick-acting zinc content (0.5-0.8 ppm), and after zinc was added, yields increased remarkably.

(2) Upland Soils

In Hubei Province, upland soil is largely upland yellow soil, which is concentrated in a line running from Xiangyang, Guanghua and Zaoyang Prefectures in the uplands of northern Hubei over an area of about 4.15 million mu. The principal mother material turned into soil in the uplands of northern Hubei is Quarternary Era clayey soil. As a result of differences in the lay of the land, erosion, hydrological features, and maturation, upland yellow soil may

be roughly divided into yellow soil, liaojiang soil, white clay belozem, and black earth phaiozem. Yellow soil is found at the tops of flat hills, and liaojiang soil is distributed in crumbled dry ravines or seriously eroded areas. In areas of flat uplands with gentle slopes, the soil layer is friable and gray or white in color. In lowest lying terrain gullies, the soil is black as a result of poor drainage (see Figure 7).

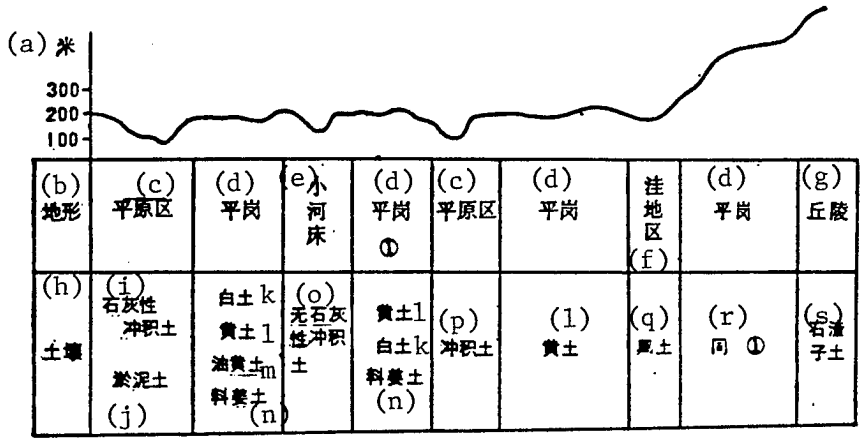

Figure 7. Sectional Drawing Showing Upland Soil Distribution in Northern Hubei Province

Key:

a. Meters
b. Topography
c. Plains area
d. Flat upland
e. Creek bed
f. Lowlands area
g. Hills
h. Soil
i. Limestome alluvium
j. Puddly soil
k. White clay
l. Yellow soil
m. Oily yellow soil
n. Liaojiang soil
o. Nonlimestone alluvium
p. Alluvium
q. Black earth
r. Ditto (1)
s. Broken rock soil

The yellow soil area is largest accounting for between 60 and 70 percent of the total uplands area. It is the principal soil in the uplands of northern Hubei. The cultivated yellow soil layer is thin, and is underlain with a heavy clay subsoil and a lower stratum that do not lend themselves to cultivation. Porosity is poor; the soil is fairly lacking in organic colloids; and it shows poor water retention capacity. It is sensitive to both drought and waterlogging, "needing water after 3 days without rain and spewing forth muddy water after 3 days of rainfall." It is low in organic matter. Except for the cultivated layer, which has a greater than 1 percent organic content, other layers have less than 1 percent. Nitrogen and phosphate are universally lacking (and this is a principal reason for the late development of upland crops). The soil tests out as being neutral (see Table 1-9).

Table 1-9. Major Physical and Chemical Characteristics of Upland Yellow Soil

Soil characteristics	Average value
pH value	6.7
Organic matter (percent)	1.0508
Complete nitrogen (percent)	0.0745
Complete phosphate (percent)	0.0917
Complete potash (percent)	2.0667
Quick-acting phosphate (jin/mu)	2.3
Quick-acting potash (jin/mu)	25.5
Salt radical exchange (m.e./100 grams of soil)	21.32
Salt radical degree of saturation (percent)	80
Proportional silicon, iron and aluminum	2.30
Physical clay particles (smaller than 0.01 mm) percent	48.44
Moisture absorption percent	6.75
Amount of water maintained infields percent	27.30
Crop atrophy water content percent	10.90

Liaojiang soil is frequently mixed in with yellow soil, the soil layer having blobs of calcium carbonate nodules. The soil is clayey and does not hold water or fertilizer. When dry, it is crumbly; after a rain it forms a paste, and it does not cultivate well. Organic content is particularly low, frequently being less than 1 percent in the surface layer. This is the least fertile of the upland soils of northern Hubei.

The cultivated layer of white clay is thick, the surface layer fairly friable, and soil texture runs from medium to heavy. It lends itself to cultivation and is fairly resistant to drought and waterlogging. In terms of the degree of its maturation, white clay may be divided into oily white clay, white clay, and cold white clay. Oily white clay results from the maturation of white clay that has been fairly heavily manured and intensively farmed. Its cultivatability and its fertility are better than that of white soil. Crop yields are high and consistent. This is the upland soil of northern Hubei that produces high yields of cotton, wheat, sesame or paddy rice.

In places where drainage is worst, the entire soil layer is black. The blackness of this soil does not result from high organic matter, but rather from poor drainage. It is caused by the physical reduction of iron and manganese. A change to the growing of paddy rice in black soil generally results in tremendous increases in yields.

Many years experience in the improvement of upland yellow soil has shown that water conservation and increased fertilization must be a key link in improving upland soil fertility. As a result of the building of water conservancy and the increased growing of green manure, the upland yellow soil wetland area has markedly increased, and utilization of upland yellow soil has changed fundamentally.

(3) Low Mountain and Hill Region Soils

Hubei has a vast area of low mountains and hills. Its topography is complex, and it has a variety of weathered mother material; thus soil types in low mountain and hill regions are fairly numerous, principally yellow soil, magan soil, baishan soil, red yellow soil, sandy loam and blue agrilla.

Yellow soil, magan and baishan soils are distributed in low mountain and hill regions throughout the province, except in Enshi Prefecture, but these soils are most widespread in the hill region of central Hubei. These three kinds of soil cover an area of more than 4.8 million mu (baishan soil covering an area as high as more than 6 million mu). Mostly these soils are found in wetlands. About 60 percent of the yellow soil is in wetlands, and 80 percent of the magan soil is in wetlands. Wetlands account for 90 percent of the baishan soil. Frequently these soils are found next to each other, the distribution of yellow soil and magan soil being fairly high, generally on the upper slopes and tops of hills in the hill region. Baishan soil occurs less frequently, usually in fields on the lower slopes in the hill region and in large tracts of flat land near hills. Most of this soil developed from Quarternary Era brown clay mother material, and it exhibits a reaction that ranges from the mildly alkaline to neutral (pH 6.4-6.8).

Yellow soil [7806 0960] is clayey and dense. It has poor structure and poor porosity. Its ability to resist drought and conserve moisture is weak. Whenever large amounts of rain fall during a concentrated period of time, it erodes fairly seriously. Its cultivated layer is thin and contains much iron. Following a high degree of maturation, it may develop into a main soil or an oily yellow soil. Main soil and oily yellow soil is fertile, farms well, resists drought and waterlogging and produces high yields of paddy rice, cotton and wheat.

The cultivated layer of magan soil is fairly shallow, and is clayey and dense. It does not farm well. It is usually streaked with iron rust, and contains iron and manganese nodules. However, as a result of intensive farming and rational manuring, it may mature into "oily magan."

Baishan soil has a good structure. It is a light and friable soil containing 40 to 60 percent coarsely powdered gravel. It is able to conserve soil moisture and withstand drought, readily shows results when manured, and lends itself to the growing of wetland crops, producing consistently high yields. It is the most fertile of all the province's hill region soils. (see Table 1-10) Nevertheless, baishan soil that occurs in alluvial fields and in fields on shaded slopes is mostly "cold baishan" as a result of poor temperature conditions, slowness of seedling growth and serious cold waterlogging.

Sandy agrilla is found mostly to the north of the Chang Jiang and to the south of the Dabie Shan in the low mountain and hill region of northeastern Hubei. Here the climate is mild, rains copious, and physical, chemical and biological weathering fairly intense. Most of the mother material that forms the soil is gneiss, with some weather granite and mica clinosol. Sandy agrilla is the principal cultivated soil in northeastern Hubei. Its cultivated

layer is fairly thick, and the soil is friable. It is usually a sandy loam or a loam with good ventilation, and that shows quick results from fertilization. However, it conserves moisture poorly and is prone to serious scouring. It is rich in nutrients, having abundant quick-acting potash (60-100 jin per mu), and complete phosphate reaching 2.4-2.9 percent. Of all the province's soils, it is the one that is richest in quick acting potash and complete potash. Most of the province's double cropped rice, and its famed peanut lands, contain sandy agrilla. A very large amount of this loam soil has been turned into high yield fields through intensive farming and soil improvement.

Table 1-10 Baishan Soil Characteristics

ph value	6.2-6.8
Organic matter	1.5-2.0 percent
Complete nitrogen	0.08-0.17 percent
Complete potash	1.4-2.0 percent
Water soluble nitrogen	5-6 mg/100 grams of soil
Quick-acting phosphate	3-8 jin/mu
Quick-acting potash	20-40 jin/mu
Positive ion exchange	8-13 mg equivalent/100 grams of soil

Reddish yellow soil is distributed mostly in the low mountain and hill region of southeastern Hubei. Here the weather is mild; much precipitation falls; weathering or rock is intense, and leaching vigorous. The soil shows an acid reaction (a pH of between 4 and 6). Red in color, the soil is rich in free aluminum and iron. Reddish yellow soil is not very mature. Its cultivated layer is thin (usually 3 to 4 cun); it is clayey, holds water and fertilizer poorly, is not very fertile, and is particularly deficient in quick-acting phosphate. Thus, reddish yellow soil is characterized as being thin, clayey, infertile and acidic, which seriously hurts prospects for increasing crop yields.

The reddish yellow soil area is one of high temperatures and much rainfall in which plant nutrients are rapidly transformed. Chemical elements that are prone to be lost as a result of lush plant growth may be augmented through plant root absorption and accumulation. These factors favor development of bamboo, sugarcane, tea shrubs, tea oil shrubs, tung trees, and such semitropical cash crops, as well as double-cropped rice.

Blue agrilla soil is found over a wide area. It occurs in alluvial fields in ravines and valleys, and in lowlying areas among mountains and hills throughout the province. Blue agrilla has a thick soil layer, is clayey, has high latent fertility, an organic content of about 2 percent and up to a maximum of above 3 percent, and contains about 0.2 percent complete phosphate, and 1.8-2.0 percent complete potash. However, since most of the places of its occurrence are lowlying where water accumulates during a large part of each year and where sunshine is insufficient, beneficial aerobic micro-organisms do not proliferate and decomposition of manure tends to be slow. Frequently as a result of low temperatures and water immersion, serious cold waterlogging results.

(4) Mountain Soils

Hubei Province's mountain regions contain principally four types of soil, namely mountain yellow soil, rock debris soil, ashen gray soil, and mountain sandy soil. These are distributed mostly in Enshi, Yichang and Yunyang Prefectures and in the southwestern part of Xiangyang Prefecture. Today about 80 percent of them are used for dryland farming.

In the western mountain regions of Hubei, vertical changes in soil properties are marked. Where the terrain is fairly low, generally the soil's organic content is low, and the soil is fairly clayey. However, as the terrain rises, temperatures gradually decline, and moisture increases, use of land for agricultural purposes decreases, and the natural cover rate increases. As a result the organic matter gradually increases, hydration becomes greater, and the color of the soil consequently changes gradually from red to yellow. In places where the terrain is fairly high and slopes fairly steep, as a result of serious scouring, the old soil layer is thin, and it is interspersed with large quantities of gravel and bits of rock.

Mountain yellow soil developed largely from limestone and Quarternary Era clay mother material. It has a high organic content, exhibits an acidic reaction. Crop growing seasons are short, and mountain yellow soil differs from hill yellow soil. Mountainland yellow soil forms a thick layer that is evenly spread, and is fine and smooth. It is the principal soil in which grain is grown in mountain regions. On flatlands, and in gently sloping areas, yellow soil frequently matures to become normal soil. Normal soil structure is excellent and the soil is fertile (see Table 1-11). It is the finest soil in the western mountainlands and suited to the growing of various crops such as corn, sweet potatoes, soybeans, rape, wheat, barley and naked barley and paddy rice. Yields are consistently high, and mostly three crops are grown every 2 years. On steep slopes, yellow soil is clayey, lacking in fertility, rather highly acidic and greatly eroded. It is generally suited only to the growing of a single crop each year of corn or sweet potatoes from which yields are low and inconsistent.

Rock debris soil is one of the principal soils on which early grain crops are grown in the mountain regions of Hubei Province. It is found on terrain at fairly high elevations and where slopes are fairly steep. Types of mother material are fairly complex. In the mountain regions of western Hubei, the mother material is principally shale, slate and limestone. In eastern Hubei, it is largely marble, gneiss, and micaceous shale. Rock debris soil is a soil formed from severe scouring by runoff, and from drift bed. The soil layer is usually shallow and interspersed with weathered gravel and broken slivers of rock. Pores are numerous and large, and ventilation is very good. However, it leaks away both water and fertilizer; it is prone to drought; and it is readily eroded. In western Hubei, mostly corn, and pulses are grown on it; in eastern Hubei, it is used mostly for the growing of peanuts and sweet potatoes.

Table 1-11 Comparison of Normal Soil With Yellow Soil

Particulars	Kind of soil	
	Yellow soil	Normal soil
pH value	5.4	6.4-7.5
Organic matter	1.5-2.0 percent	2-3.5 percent
Complete nitrogen	0.13-0.14 percent	0.2 percent

Ashen gray soil is found mostly on the tops and upper slopes of high mountain areas of western Hubei. The mother material from which this soil is formed is limestone, sandstone and mica schist. Here forest trees proliferate and there are numerous kinds of trees including metasequoia, fir, oak and lacquer trees. This is an area of Hubei Province that produces large amounts of timber forest trees and economic forest trees. Furthermore, the weather here is very changeable and rainfall copious. Physical, chemical and biological weathering of the mother material is very intense; thus a thick, friable layer of soil has also formed on mountain tops. Low temperature conditions on high mountains means extremely cold winters during which the soil frequently freezes to a depth of more than 1.5 meters. As a result, plant remains cannot fully decompose, and although much organic matter accumulates, its nutrients cannot be readily released. (see Table 1-12) Ashen gray soil is frigid in varying degrees. On leeward slopes or in limestone cave areas, its frigidity is greatest.

Table 1-12 Characteristics of Ashen Gray Soil That Has Developed on Limestone (Lucunpo in Badong County)

Depth (cun)	0-4	4-20
Organic matter percent	11.745	4.515
Complete nitrogen percent	0.559	0.2470
Complete phosphate percent	0.1437	0.1056
Complete potash percent	2.1204	2.1203
pH value	5.0	5.3

Mountainland sandy soil is found principally in the western mountain region of Hubei on two mountains, on low mountains, and in hill regions. It is a coarse and friable soil of low fertility, that does not retain water, and that is prone to scouring. It is suited to the growing of tuberous and vine crops such as sweet potatoes and potatoes.

Fourth Section. Water Conservancy Resources and Water Energy Resources

1. Water Conservancy Resources

(1) Surface Water Resources

Hubei Province receives copious rainfall. It is also crisscrossed by streams, has numerous lakes, and is dotted with reservoirs and ponds. It has a large amount of runoff. Surface water resources are extremely abundant, and potential for their development for use is very great.

1. Surface and Runoff Resources

The main river in the province is the Chang Jiang. Tributaries from surrounding mountains converge on the Chang Jiang to form a water system centering on the Chang Jiang. In addition to the Hanshui, other major tributaries that flow directly into the Chang Jiang include the Fushui, Qishui, Xishui, Bashui, Jushui, Daoshui, Sheshui, Fu He, Huanshui, Jinshui, Lushui, Juzhang He, Yunshui, Huangbo He, Xiangqi He, Yuyang He and Qing Jiang. Major tributaries that flow directly into the Hanshui include the Tianmen He, Dafushui, Man He, Nan He, Du He, Tian He, Tangbai He and Tao He. The province has a total of 1,193 rivers, large and small (exclusive of the Chang Jiang and the Hanshui) totaling more than 35,100 kilometers in length.

For many years runoff in the province has totaled an average of about 100 billion cubic meters (not including the Chang Jiang and the Hanshui). This is twice the volume of water in the Huang He. This includes a runoff totaling 62 billion cubic meters from 25 major rivers large and small, including the Qing Jiang, the Du He, and the Fushui. (see Table 1-13) This shows that Hubei Province has abundant local runoff that can be impounded for use. In addition, within the border of the province flow two rivers that originate outside the province, the Chang Jiang and the Hanshui. For many years, their volume has averaged 813 billion cubic meters. Hubei Province is located in the middle reaches of the Chang Jiang, and it also lies astride the Hanshui over three-fourths of its length. Volume of water flowing through the Hanshui is close to one-fourth that in the Chang Jiang. As a result, the province has a substantially abundant amount of water from outside that can be used supplementarily. The two huge rivers, the Chang Jiang and the Hanshui, provide extremely favorable conditions not only for inland river transportation, but also for development of agriculture on the Jianghan Plain and in areas on both their banks in Hubei Province. However, as a result of the abrupbt convergence of waters from outside the province with local runoff during the flood season, the threat of flooding and waterlogging is very great.

Hubei Province's abundant surface runoff resources await further development and full use. It has been estimated that as of the end of 1978 about 38.5 billion cubic meters of surface water (including the amount in the Danjiangkou Reservoir) was being impounded, diverted, or raised for use. This was about

Table 1-13 Water Conservancy Resources in Hubei Province's Major Medium Size and Small Rivers

(b) 项目 / 河名 (a)	(c) 河长 (公里)	(d) 流域面积 (平方公里)	流量 (方/秒) 平均流量 (f)	流量 (方/秒) 历史最大流量 (g)	径流深 (h) (毫米)	年径流总量 (i) (亿立米)	水力蕴藏量 (j)(万千瓦) 理论 (k)	水力蕴藏量 (j)(万千瓦) 可开发 (l)
Qing Jiang	427.3	16,770	441	16,350	857	142	224.3	171.2
Du He	318	11,725	190	12,400	565	66.2	116.2	62.0
Juzhang He	341.2	7,338.7	77		438	31.6	23.0	8.5
Yunshui	266	12,866	119	17,000	276	35.5	9.5	2.6
Nan He	235	6,343	78	15,800	396	25.1	51.9	19.7
Lushui	192	3,943	95.5	11,300	776	30.6	14.2	10.1
Fushui	180	5,310	110		848	41.6	14.5	11.3
Jushui	170.4	4,054.6	46.4	8,200	483	19.6	6.1	4.0
Xishui	165.6	2,504	525	17,000	615	15.3	9.5	9.6
Huangbo He	152.5	1,894.8			483	9.84	10.3	7.6
Daoshui	163	1,793	22.4	3,490	448	8.0	1.7	1.1
Bashui	151	3,306	59.5	7,900	618	20.4	8.0	5.5
Man He	151	3,086	44.3	8,050	457	14.1	6.4	3.7
Dafushui	149	1,554	17	2,180	359	5.58		
Weishui	148	1,691	50.7	8,340	917	15.5	6.3	4.5
Jinshui	144	2,710	48.4		621	27.4		
Tianmen He	137	3,113	21.2	1,010	294	9.16		
Tao He	134	1,669	8.3	3,280	189	3.17	3.3	1.3
Huanshui	133	3,456			360	12.4	3.2	1.3
Gun He	125	2,797	16	6,060	182.2	5.08	1.0	1.0
Qishui	118	1,913	39	4,220	669	13.2	1.7	2.7
Sheshui	112	2,172	30.4	6,640	420	9.1	4.9	0.4
Xianqi He	193.5	3,099.4	69.5	4,830	695	21.6	34.6	5.1
Yuyang He	97.7	1,189.7	34.2	3,300	1002	11.9	8.1	6.5
Tian He	69	1,614	15.2	3,300	290	4.69	4.5	1.2
Tangbai He	135	235	16.0	18,553				

(m) 唐白河大部分在河南省境内。

Key:

a. Name of river
b. Particulars
c. River length (kilometers)
d. Basin area (sq kms)
e. Flow volume (cubic meters/second)
f. Average volume of flow
g. All-time high volume of flow
h. Depth of runoff (millimeters)
i. Total annual runoff (100 million cubic meters)
j. Hydropower reserves (10,000 kW)
k. Theoretical
l. Developable
m. Most of the Tangbai He lies in Henan Province

38 percent of the province's average total runoff, but the amount varied greatly from place to place. Generally speaking, the runoff is used rather well in Jingzhou, Xiaogan, Xiangyang, Huanggang and Xianning Prefectures where the utilization rate is more than 40 percent. However, in Enshi, Yunyang and Yichang Prefectures in the western part of the province, the utilization rate is less than 10 percent. Because of the runoff distribution and the unbalanced utilization rate, plus changes in the annual distribution of precipitation in recent years, existing water conservancy projects cannot cope with great droughts or the draining of major waterlogging. It will be necessary in the future to continue the capital construction of farmlands centering around harnessing of water and improvement of soil in a vigorous effort to tap the huge potential that surface water and runoff resources provide in Hubei Province. This is a task that cannot wait.

2. Water Resources Impounded in Lakes, Reservoirs and Ponds

Lakes abound in Hubei Province's plain lake region. Statistics from before 1959 showed about 1,066 of them (not counting small lakes less than 100 mu in area), but as a result of reclamation of lakes to make farmland, by the end of 1977 the number had fallen to 326. The numerous lakes play a role as natural reservoirs. The province's lakes, if figured at 4 million mu, can take in more than 15 billion cubic meters of water in a year of abundant rainfall, thereby reducing flood water pressures from the Chang Jiang and the Han Shui to a certain extent. When river water levels fall, lakes supplement streams with the volume of water impounded in them. They increase the amount of water in rivers during the dry season, and play a very great role in navigation, generation of electric power and irrigation.

In order to make sure, over a period of time, that farmlands have water during drought, and that water is drained away during waterlogging, the province has capitalized on the numerous river valleys among its low mountain and hill regions and its abundant water resources to build projects for the impounding of a large volume of water in reservoirs and dammed ponds. As of the end of 1978, the province had built 6,096 large, medium and small reservoirs (see Table 1-14) to control a more than 30,000 kilometer area and store 24.448 billion cubic meters of water. This included a 14.2 billion cubic meter volume that could be effectively used to irrigate effectively an 18 million mu area. The province also built 1,189,100 dammed ponds holding an effective volume of 2.8 billion cubic meters of water to irrigate a 7,528,500 million mu area. Practice has shown the building of projects to impound water to be a way to make full use of water resources, and also a vigorous measure for surmounting natural disasters.

(2) Ground Water Resources

Not only does Hubei Province have a large quantity of surface water, but very abundant ground water as well. Preliminary survey shows tappable ground water resources in the whole province totaling 48.61 billion cubic meters annually. This is about half the province's surface water. This includes about 37.15 billion cubic meters per year in mountain regions, and 11.46 billion cubic meters per year on plains and uplands.

Table 1-14 Statistical Table on Water Impounding Projects in Hubei Province

(a) 地、市	(b) 水库							(c) 塘堰	
	(d) 处数	总库容 (e) (亿方)	有效灌溉面积(f) (万亩)	(g) 其中: (处) 大(h)型	中(i)型	小(一)(j)型	小(二)(k)型	处数 (l) (万处)	蓄水 (m) (亿方)
Whole province	6,096	244.48	1,798.75	45	213	1,041	4,797	118.91	28.03
Huanggang	1,090	48.93	412.95	12	36	169	873	29.48	5.43
Xiaogan	725	29.1	263.99	5	23	150	547	26.42	5.24
Xianning	643	44.66	148.84	6	22	98	517	7.08	2.54
Jingzhou	707	54.06	380.69	6	34	171	496	22.01	5.78
Xiangyang	1,425	50.85	398.89	15	68	199	1,143	20.11	4.82
Yunyang	459	3.4	34.22	—	6	63	390	1.55	0.7
Yichang	502	9.15	101.91	1	18	94	389	8.8	1.77
Enshi	208	1.49	16.12	—	2	37	169	1.08	0.39
Shiyan	24	0.42	1.17	—	1	4	19	0.08	0.06
Huangshi	127	1.64	25.47	—	3	26	98	1.13	0.16
Wuhan	186	0.78	14.5	—	—	30	156	1.17	1.14

Key:
a. Prefecture or city
b. Reservoirs
c. Dammed ponds
d. Number of sites
e. Total capacity (100 million cubic meters)
f. Effectively irrigated area (10,000 mu)
g. Including: (Sites)
h. Large
i. Medium
j. Small (1)
k. Small (2)
l. Number of sites (10,000)
m. Impounded water (100 million cubic meters)

The province's ground water occurs mostly in the following two different kinds of places. First is bedrock mountain regions where the principal water bearing petrofabric is a carbonate type fissured karst water bearing petrofabric.[1] This kind of water bearing petrofabric is found largely in southwestern Hubei, in southeastern Hubei, in the Dahong Shan, in Beixun County in northwestern Hubei, and along the border with Henan Province. However, in northeastern Hubei, and in the metamorphic and magmatic rock areas of the Wudang Shan, ground water resources are fairly scant. In areas of distribution of carbonate type water bearing petrofabrics, ground water is abundant. Initial calculations show storage of as much as 31.15 billion cubic meters annually, or

1. Carbonate rock types include mostly limestone and dolomite, both of which are readily soluble in water.

64 percent of the underground water throughout the province. This includes 7.06 billion cubic meters per year that flows out of springs or underground streams, most abundantly in Enshi and Xianfeng Counties. The province's carbonate rock distribution is most widespread in the southwest, which is the region where karst topography is most developed. Within this area, underground streams, subterranean drainage, and ground water appear and disappear in streams that flow unceasingly. In this region, the general volume of flow is between 300 and 1,000 tons per hour from springs, and between 2,000 and 2,500 tons per hour from underground streams. Ground water resources are extremely abundant.

The second kind of place in which ground water occurs most commonly is in loose rock type fissured, water-bearing petrofabric on the Jianghan Plain, in the northern Hubei uplands, and in mountain basins.[1] In plains areas, it is mostly in first and second levels of stepped streams. The amount of water contained in such water-bearing petrofabric is second only to that found in carbonate rock types, approximately 10.98 billion cubic meters annually (not including uplands ground water resources).

In carbonate rock regions where ground water widely occurs, though the water is very abundant, it is fairly difficult to extract because of the complex hydrogeological structure. Ground water can be readily obtained only from rock strata in which water level pressure pushes it upward at a slant, usually termed anticlinal plunge [5154 2438 0282 0126 4551], and from central area rock strata in which water level pressure causes cave-ins, usually termed synclinal nuclear valleys [0680 2438 2702 6752 6253 0966], as well as from places from which ground water drains away, and in points of contact along tracts of sandy shale.

Most ground water flows through several strata following structure lines to low places. Thus, the Jianghan graben fault basin acts as a natural "subterranean reservoir" for regulating surface water and ground water in the province. A preliminary survey of ground water done during the past several years in the northern Hubei uplands has discovered that at a depth of between 50 and 150 meters beneath most of the uplands lies a moderate amount of water of fine quality that can be tapped for use to provide about 480 million cubic meters annually.

Ground water is clean, little affected by atmospheric temperatures and reserves remain fairly stable. Today, in addition to being used for drinking and industrial use, ground water has been more and more developed for use in agriculture in Hubei Province. Not only has development of ground water been a major way in which to solve water conservancy problems for those areas of the province that lack surface water and are at the outer limits of reservoir supply, and for uplands, but the experience of some counties on the Jianghan Plain in the use of ground water has shown that even in places where surface water is plentiful, a certain amount of ground water may be pumped from wells for irrigation. In drought years, plains areas can more easily and more economically irrigate their fields with ground water than through pump irrigation.

1. Loose rock includes principally gravel, pebbles and Quarternary Era sediment.

Some lowlying areas along rivers in northern Hubei have also been fairly successful with sinking wells to drain away stagnant water and eliminate waterlogging.

2. Water Energy Resources

(1) Hydroelectric Power Resources

Hubei Province with its numerous mountains, rivers, lakes and supplies of water has extremely plentiful hydropower resources. Preliminary surveys show that in addition to the Chang Jiang and the Hanshui, the province has 25 tributary streams (not counting Tangbai He) with a basin area of more than 1,000 square kilometers, and that they hold reserves of more than 6 million kilowatts.[1] Among them, streams with reserves of more than 1 million kilowatts include the Qing Jiang and the Du He, and those with reserves of more than 100,000 kilowatts include the Nan He, Huangbo He, Juzhang He, Xishui, Qian Jiang, Jia He, Fushui, Lushui, Xiang Qi, and Fu He. Of the province's 73 counties (including the Shennongjia forest area), 57 have small hydropower reserves of more than 10,000 kilowatts. This is 78 percent of counties. Of these, 45 counties have reserves of more than 20,000 kilowatts, and 26 counties have reserves of more than 50,000 kilowatts. Reserves are largest in Luotian, Tongshan, Nanzhang, Enshi and Zhushan Counties. At the present time, terracing of medium and small streams can be continued as part of their all-around development for use. In addition, existing reservoirs could produce more than 50,000 kilowatts of electric power with the installation of hydropower generating equipment. All these circumstances provide extremely fine conditions for Hubei Province's development of water energy resources for use.

Hubei's hydropower resources are distributed everywhere throughout the province and are characterized as follows: High mountains with steep slopes in the province's western mountain region where the current rushes, the drop is great, the volume of water is ample, and hydropower resources are extremely plentiful. For example, the Qing Jiang, which flows through this area, has hydropower reserves of more than 2,243,000 kilowatts, and the Du He's reserves are greater than 1,162,000 kilowatts. In the eastern mounts of Hubei, hydropower reserves are also plentiful. Though development of hydropower resources on the Jianghan Plain is limited, culvert floodgates, pumping stations, river diversions, and the waters of the Hanshui can be used to generate electricity. In Jingbei and Hanbei Prefectures, construction of a group of low head, large volume of flow electric power stations could be done to increase the seasonal supply of electric energy to agriculture, as well as to link together the power grids of plains areas and mountain or hill regions to regulate the imbalance in use of electricity.

1. In addition to the hydropower reserves of the 22 rivers listed in "Major Medium and Small Stream Water Conservancy Resources of Hubei Province," this includes 150,700 kilowatts from the Xishui, 139,000 kilowatts from the Qian Jiang, 116,400 kilowatts from the Jia He, 73,140 kilowatts from the Yandu He, and 21,700 kilowatts from the Jin He.

With development of water conservancy construction, remarkable achievements have also been made in use of the province's water energy resources. As of the end of 1978, 3,070 large, medium and small hydroelectric stations had been built in the province with equipment to produce 1.5 million kilowatts. This included 3,064 small hydroelectric stations with an installed capacity of 309,000 kilowatts. Large and small hydroelectric stations generated 3.5 billion kilowatt hours of electricity.

Since Liberation Hubei Province has constructed 13 large electric power stations (see Table 1-15), which account for 50.67 percent of total installed capacity in the province's hydroelectric stations. Clearly, use of water power to generate electricity holds an important position in the province's electric power projects. Furthermore, of the hydroelectric resources developed in the province, except for Danjiangkou, installed capacity of medium and small hydroelectric stations amounts to only 10 percent of hydropower reserves, so there are still tremendous water energy resources awaiting development for use.

Table 1-15 Installed Capacity of Large Electric Power Generating Stations in Hubei Province (as of 1978)

Station name	Nature of power	Installed capacity (10,000kW)
Grand total		235.16
Dan Jian	Hydropower	90
Huanglong	Hydropower	15
Bailian He	Hydropower	4.5
Fushui	Hydropower	3.4
Lushui	Hydropower	3.52
Dongzhi	Hydropower	1.5
Xizhai	Hydropower	1.24
Subtotal		119.16 (50.67 percent of total)
Qingshan	Coal. Oil	66.2
Huangshi	Coal	26.0
Siliuyi	Coal	5.0
Shashi	Coal. Oil	4.8
Wuchang	Coal	1.5
Jingmen	Oil	12.5
Subtotal		116.0 (49.33 percent of total)

(2) Geothermal Resources

Terrestrial heat is an energy source that has aroused an increasing amount of serious attention. Today it is used not only for tanning, printing and dyeing, sizing, medical treatment and for the extraction of minerals, but has found widespread applications in agricultural production as well. In addition, use of terrestrial heat for the generation of electricity also holds wide prospects.

Terrestrial heat resources are located primarily close to certain structural belts in which movement of the earth's crust is fairly violent. The working people of Hubei Province have given attention to terrestrial heat resources and their use since very early times. County records for Yingshan County show that as long ago as the Ming Dynasty warm springs were located at four sites over a distance of 30 Chinese li, and were known as north, south, east and west "spas," from which water vapor wafted in winter, and which emitted mist in summer. Today, hot water issues from the ground at 45 places in 29 of the province's counties and cities. This includes five sites where the water is very hot (more than 60°C) at Yingshan, Luotian and Yingcheng. At 15 sites, the water is moderately hot (40-60°C). These are located in southwestern Hubei, in the Dahong Shan and the Dabie Shan, and in Changyang and Songzi. At 25 sites, the water is of low temperature (20-40°C). Most of these sites are located in northwestern Hubei. (see Figure 8) Experiments have shown excellent results obtainable from the use of underground hot water at above 30°C to soak paddy rice seeds, the use of warm water below 30°C for irrigation, and the use of underground hot water above 40°C in hot houses for growing vegetables. Today the province has 32 hot springs in which the water temperature is as high as 30°C. In 18 of these springs, water temperature is higher than 40°C (see Table 1-16).

In recent years attention has turned throughout the province to the application of terrestrial heat to agriculture, and some initial results have been achieved. Yingshan County has used water from the Xiyang He and Dongyang He hot springs to grow superior rice varieties and for winter propagation of seedlings. Yingcheng, Jingshan and Luotian Counties have used local hot springs water in successful experiments with the overwintering of lotus plants and African crucian carp. Today, not only do lotus seedlings and African crucian carp meet local needs, but the needs of neighboring prefectures and other provinces can also be supplied. Yingcheng County has also succeeded with experiments in the use of terrestrial hot water in the hatching of chicks.

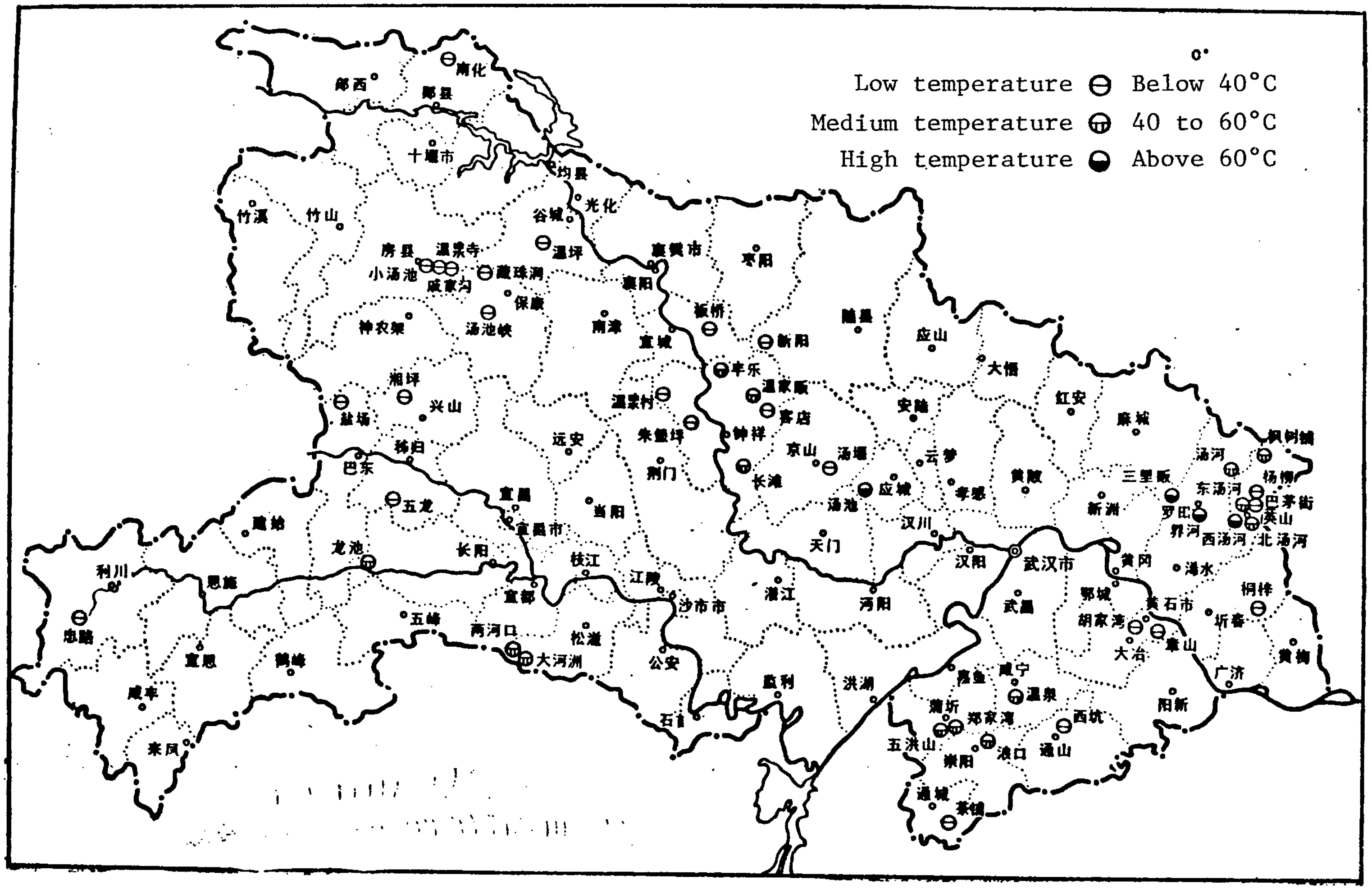

Figure 8. Map Showing Terrestrial Heat Distribution in Hubei Province

Table 1-16 Major Geothermal Sites (Above 30°C) in Hubei Province

No.	Name of warm spring: County	Name of warm spring: Name	Water temperature (°C)	Rate of flow (tons/day)	Status of use	Outlook for development
1	Puqi	Wuhongshan	Spring (1) 47° Spring (2) 43° Spring (3) 39°	Unknown	Runs away unused	Can serve agriculture after improvement
2	Puqi	Zhengjiawan	Spring (1) 43° Spring (2) 42°	Unknown	Not used	If the rate of flow is large, it can serve agriculture
3	Chongyang	Langkou	45°	90.374	Not used because of small rate of flow	Vast terrain with convenient transportation. Worth further exploration
4	Xianning	Wenquanzhen	50°	Unknown	Medical treatment (195 hospitals already built)	Eight openings; can be developed further to serve agriculture
5	Tongshan	Louxia	41°	38.88	Not used because of small flow	Not easily used for irrigation because of sodium carbonate
6	Daye	Zhangshan	37°	Unknown	Not used	Certain hydrogen sulfide and hydrogen carbonate content makes it useful in medical treatments but not in agriculture
7	Huangshi	Hujiawan	32°-38°	Unknown		
8	Jinchun	Tongxin	Spring (2) 44° Spring (3) 40° Spring (5) 49.5°	144.89	Used for raising lotus plants, African crucian carp and for bathing	Vast area with convenient transportation. Good prospects for exploitation
9	Yingshan	Xitang He	Spring (1) 64° Spring (2) 69.5°	1,283	Used for raising seedlings and cotton for raising lotus plants, for the rearing of	With expansion of flow and solution to cold water supply, a geothermal electric power plant can be built

[continued]

Table 1-16 [continued]

No.	Name of warm spring: County	Name of warm spring: Name	Water temperature (°C)	Rate of flow (tons/day)	Status of use	Outlook for development
9	[continued]				African crucian carp, for irrigation, medical treatment and tanning	
10	Yingshan	Beitang He	64°		Used in daily life and for bathing	Can be widely used in agriculture
11	Yingshan	Dongtang He	46°		Used for winter raising of lotus plants and for rearing African crucian carp	Same as above
12	Yingshan	Bammaojie	34°		Appears only in dry season so not used	Use very much limited
13	Luotian	Fengshupu	53°	70	Not used	If the rate of flow is large, it can serve agriculture
14	Luotian	Tang He	45°		Not used because of dispersed flow	Can serve agriculture after improvement
15	Luotian	Cengjiafan	61.5°		Not used because of low point of discharge	
16	Luotian	Sanlipan	73°	312	Rearing of African crucian carp and winter raising of red azolla	Once major openings determined and rate of flow increased, may be used to make electricity
17	Yingcheng	Tangchi	69.3°	3,067	Raising seedlings, propagating paddy seeds, rearing African crucian carp, hatching chickens and ducks, and medical use	Deeply probed and dug to below 200 meters to expand flow to 11,964 tons/day and generate 110 kW of electricity

[continued]

Table 1-16 [continued]

No.	Name of warm spring: County	Name	Water temperature (°C)	Rate of flow (tons/day)	Status of use	Outlook for development
18	Yingshan	Tangyanpan	41°	2,000	Winter raising of lotus and propagation of seedlings; propagation of paddy seeds and rearing of African crucian carp	May be widely used in agriculture
19	Zhongxiang	Kedian	38°	78.8	Paddy seedling propagation and raising of azolla	Usable for agriculture
20	Suixian	Xinyang	37.7°	723	Winter raising of lotus	
21	Yicheng	Banqiao	30°	603.42	Same as above	
22	Shenxiang	Fengle	43.5°	1,000	Propagation of superior paddy varieties, and cotton and corn seedlings	
23	Shenxiang	Zhubaoping	39°	580.61	Same as above	
24	Gucheng	Wenping	34°	345.6	Winter propagation of lotus and for raising of seedlings for whole county	
25	Fangxian	Zhuzangdong	34°		Not used because of location in remote mountain region	Growing of seedlings in hothouse under consideration, plus hatching of fish
26	Baokang	Wenchixia	36.8°	704	Same as above	
27	Fangxian	Xiaotangchi	34°	6,048	Same as above	Same as above

[continued]

Table 1-16 [continued]

No.	Name of warm spring: County	Name	Water temperature (°C)	Rate of flow (tons/day)	Status of use	Outlook for development
28	Fangxian	Wenquanshou	37.7°	8,640	Not used	Same as above
29	Badong	Yanchang He	32.5°	1,728	Used for making salt before Liberation; not used now	Limited value for agricultural use; may be used in multiple ways
30	Changyang	Yanchi	42.5°	603.9	Used for bathing	
31	Songzi	Lianghekou	43.6°		Not used because of too low a position of occurrence	Large volume estimated; valuable for tapping
32	Lichuan	Zhonglu	32°	810	Irrigation and bathing	Wide usefulness to agricultural production

Fifth Section. Fertilizer Resources

The present situation for fertilizer resources in Hubei Province is as follows: The principal sources of organic fertilizer are green manure and human and animal excrement. Use of plant stalks and stems as fertilizer accounts for between only 5 and 10 percent of total organic fertilizer. Fertilizers of mineral origin, such as phosphate are most plentiful, and potassium resources are fairly widespread (see Figure 9). In the use of resources, first must be vigorous development of green manure, full use of phosphate fertilizer, and active use of potash fertilizer. Development of the animal husbandry industry is also necessary in order to increase the amount of barnyard manure. Development of methane gas and solar energy stoves to solve rural energy problems will permit return to the soil of plant stalks and stems.

1. Green Manure Resources

Green manure is plentiful in Hubei Province, and it provides a large quantity of fine quality organic fertilizer for the growing of farm crops such as grain and cotton. In 1978, the province grew green manure on 23.16 million mu, including 16.54 million of Chinese milk vetch, 1.92 million mu of Chinese trumpet creeper, 1.82 million mu of azolla, 920,000 mu of false hemp, 90,000 mu of false indigo, and 60,000 mu of common vetch. In addition, it grew various kinds of green manure such as common artemesia, gallnut, boluohui [0590 5507 0932], shrub lespedeza, vetch (Vicia sativa), California bur clover, tianlan [1131 5695], Japanese clover sespedeza striata, tianzaojiao [3944 4103 6037], coriaria, milk vetch [Astragalus membranaceus], jucao [5484 5430], cordate houttuynia [Houttuynia cordata], Asia pucoon, and pond weed [potamogeton polygonifolious].

Use of green manure resources in Hubei Province may be characterized in the following ways: Red, yellow, blue, white and purple green manures are grown in spring, summer, autumn and winter. During autumn and winter Chinese milk vetch, Chinese trumpet creeper and red indigo are grown, and during spring and summer, false hemp, white and yellow flowered sweet clover, and false indigo are grown. Chinese milk vetch is the locally dominant fertilizer used for the early paddy crop, and Chinese trumpet creeper and red indigo are the locally dominant kinds of fertilizer used in some places in the growing of intermediate rice and cotton. False hemp, and white flowered clover are now being tried out as major organic fertilizer sources for the growing of rice and wheat in a two crop system. Sesbania and nitrogen-fixing fragrant thoroughwort [Eupatorium fortunei] show promise as a source of fertilizer for a second crop of late rice.

Full use of green manure resources, expansion of the area devoted to the growing of green manure, and increasing green manure output will be the major actions taken for a considerable time in the future for increasing the province's grain and cotton yields. Dryland and paddy field growing of rice, wheat, cotton, oilbearing crops, fruit trees, and local specialties will require the growing of green manure for use as a base fertilizer. Even should

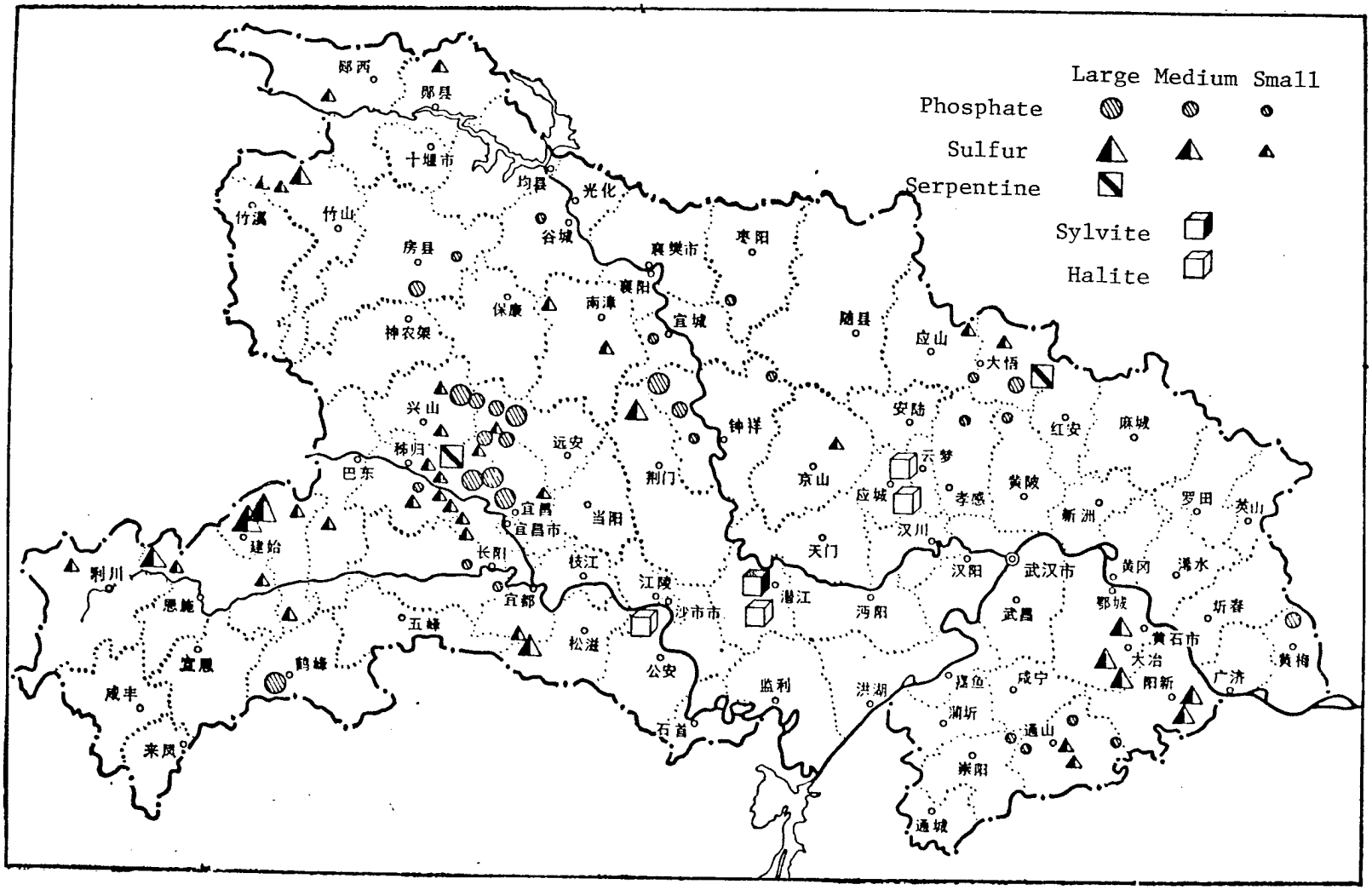

Figure 9. Map Showing Distribution of Agricultural Mineral Fertilizer Resources in Hubei Province

the amount of chemical fertilizer use reach a substantial level, it will still be necessary to use green manure in conjunction with it in order to increase the amount of organic matter in the soil. As the farming system develops and the multiple cropping index rises, the overall trend should be toward increase in the growing of dryland green manure, short term green manure, water growing green manure and green manure in the four sides beside roads, streams, villages and houses. Output of paddy field Chinese milk vetch must be increased at the same time, with the gradual growing of "1 mu of green manure for every 2 mu." Varieties of all kinds from the north, south, east and west should be continued to be incorporated into use and planting techniques should include intercropping, interplanting and transplanting to make fullest use of the light and heat resources between rows of crops and between the time when consecutive crops are grown on the same land. A mixture of green manures should be sown (as, for example, Chinese milk vetch, rape and manyuanhua [3341 0954 5363]) to increase green manure output.

2. Phosphate Fertilizer Resources

The major raw material used in Hubei Province to produce phosphate fertilizer, phosphate rock, is distributed widely in large reserves in the province. Eight of the province's prefectures have phosphate rock resources. The prospected mining area has turned up phosphate rock at 37 places, and reserves total more than 2.6 billion tons. Large and medium size mining areas number eight and are located mostly in Zhongxiang, Yicheng, Yichang, Yuanan, Hefeng, Dawu and Huangmei Counties. The quarries at Jingxiang, Yichang and Hefeng are the three most famous phosphate quarries in the province. In recent years, large and medium size phosphate rock quarries have also been found in the area around Baokang and Nanazhang in northwestern Hubei. At most of the large and medium size areas, seams are thick; the rock is extensive; the grade is high; and quality is good.

Sternbergite, the raw material for the sulphuric acid necessary in producing calcium superphosphate is rather widespreadly scattered in our province. Except for Xiaogan and Huanggang prefectures, deposits are scattered evenly in the other prefectures. There are two large mines concentrated in Jianshi County; there are 7 medium mines scattered in Enshi, Zhushan, Echeng, Yangxin and Jingmen Counties; and there are 34 small mines, the majority of which are in the southeast and northeast. Although there are many sternbergite mines in our province, the grade is poor, thickness [of seams] is thin, reserves are small, and the already proven reserves amount to only more than 8 million tons. This cannot at all meet the needs of our province in developing phosphate fertilizer production. From now on, besides for paying attention to increasing the present ore utilization rate, we must also strengthen prospecting and search for new sources in order to make farsighted preparations for exploitation.

Serpentinite, the essential component in the phosphate fertilizer containing calcium and magnesium, which is produced in our province is concentrated mostly in the Huangling anticline and in the Dabie Shan region. It is particularly concentrated at Yichang, Dawu and Jinchun. The grade of the ore in these mining areas generally meets industrial production requirements; in

addition, seams are thick, reserves are plentiful, and reserves totaling about 200 million tons have been found. In addition, in other counties in the Wudan Shan and Dabie Shan area, potential for development of serpentine is also very great.

3. Potash Fertilizer Resources

Hubei Province's potash fertilizer resources consist mostly of glaserite, syngenite, ischelite, phosphate-rich brine, pea rock [4845 6258 1484], and potash feldspar. Glaserite, syngenite, ischelite and phosphate-rich brine are distributed mostly around the area of Qian Jiang, Tianmen and Jiangling on the Jianghan Plain where reserves are being explored. A substantial amount of pea rock has been found in Enshi, Lichuan and Badong, and in the area around Echeng and Daye, where reserves are estimated at 1.2 million tons. Potash feldspar is found mostly in the Tongcheng-Yangxin area. Several hundred veins of pegmatite, large and small, have also been found in Tongcheng County, and these veins contain large quantities of potash feldspar, the content averaging around 20 percent. This includes more than 20 veins with a potassium oxide content of more than 8 percent, a grade that fully meets requirements for the making of calcium potash fertilizer. Preliminary estimates place total reserves at around 10 million tons. If medium size mines permitting extraction of 100,000 tons annually were to be built, they could be mined for 100 years. Future consideration should be given to determining long range reserves as a preliminary to the possible building of a calcium potash fertilizer plant in Tongcheng County.

4. Nitrogenous Fertilizer Resources

The province's nitrogenous fertilizer resources include natural gas, petroleum and coal. Natural gas has been discovered at Luchuan. Further prospecting is underway for its gradual development for use. Use of petroleum as a raw material for making nitrogenous fertilizer is being done only at large and medium size chemical fertilizer plants, including the Hubei Chemical Fertilizer Plant, which can use either petroleum or gas. Small nitrogenous fertilizer plants use mostly anthracite as raw material.

Hubei Province's anthracite coal resources are spread over a wide area, but reserves are small. They are located mostly in the western and southern part of the province. The paucity of anthracite coal has occasioned great difficulties for development of the nitrogenous fertilizer industry, particularly in the eastern part of the province.

5. Humic Acid Type Fertilizer

Resources for the production of humic acid type fertilizer include peat, caotan [5430 3516] weathered coal, and lignite, with peat and lignite being most important.

(1) Peat

Peat has been found everywhere in the province, but it occurs mostly in Jingzhou and Enshi Prefectures. Reserves are concentrated mostly in Honghu,

Mianyang, Jianli, Jiangling, Jingmen, Lichuan, Enshi and Xianfeng Counties. Preliminary survey shows more than 70 million tons of peat in Honghu County. Peat is a natural accumulation of organic residue from the decay under anerobic conditions of branches, leaves and roots, or the death of moisture tolerant plants, its plentiful organic matter not decomposing entirely and accumulating over the years. Peat from the Honghu-Mianyang area has a 30-40 percent organic content, 1.5-2.4 percent nitrogen, 0.89 percent potash, and 0.4 percent complete phosphate, and is worth digging up. Frequently peat is buried beneath recent deposits of lacustrine loam accumulations. In plains lake regions, it is usually buried more than 1 meter deep and no less than about 20 centimeters deep. Thickness of deposits ranges from several tens of centimeters to 3 meters. In mountain regions, it is usually buried fairly deeply, but no more than 3 meters down; thus it is easy to dig up.

(2) Weathered Coal

Wherever there are coal seams, weathered coal exists. Local geological surveys have shown coal seams in 47 of the province's counties and cities, and a definite distribution of weathered coal. Reserves are greatest in Enshi and Yichang Prefectures. It has been estimated that in Yidu County alone, weathered coal deposits amount to between 10,000 and 20,000 tons, having a dry coal content of around 40 percent and a calcium and magnesium content of less than 1 percent.

Most weathered coal deposits are shaped like a henhouse and may be mined for local use. However, since the extent of weathering differs, the humic acid fertilizer content shows substantial variation. In some the content of organic matter is fairly small, so there is little value in mining it.

In addition, lignite has been found in Puqi, Chongyang, Wuchang and Baokang in Hubei Province. This is also of value of making humic acid type fertilizer.

Sixth Section. Biological Resources

1. Forest Resources

(1) Status of Forest Resources

Hubei Province is part of the country's northern subtropical and central subtropical plant cover zone. In the province's northwestern and northeastern mountain regions, mostly deciduous broad leaf forests grow, and the vegetation is similar to that in the southern mountain regions of north China. The low mountain areas have mostly deciduous broad leaf forests and massoon pine mixed forests. Mountain regions above 1,000 meters have mostly deciduous broad leaf forests and Taiwan pine forests. Towards the south where climatic conditions are warm and moist in some areas, some evergreen forests occur. In the Wuling mountain region of the southwest and the southeast, and in the Shennongjia mountain region and the Mufu mountain region, mostly forests are a mixture of evergreen broadleaf trees and deciduous trees as well as subtropical needle leaf forests (massoon pine and cypress forests), evergreen deciduous forests and bamboo forests. In this region, the types of vegetation are the most complex in the province, and both forest resources and tree varieties are plentiful.

Hubei Province's forest area currently totals 56.58 million mu and contains reserves of 80.19 million cubic meters. Most of this timber is concentrated in the Shennongjia, Qing Jiang, Juzhang He, Mufu Shan, Dabie Shan and Dahong Shan forest zones (see Table 1-17). Among these areas, counties with forest reserves totaling more than 3 million cubic meters (not counting Shennongjia) include Zhuqi, Suixian, Fangxian, Hefeng, Luotian and Baokang. Counties in which forest reserves total more than 2 million mu include Xingshan, Wufeng, Enshi, Xianfeng, Yichang, Zhushan and Xuanen. Standing timber in the 14 aforementioned counties accounts for 58.8 percent of the province's total reserves.

Table 1-17 Forest Resources in Major Forest Areas of Hubei Province

Units: 10,000 cubic meters

Name of major forest zone	Former forest reserves	Present forest reserves	Major kinds of timber forest trees
I Shennongjia Forest Zone	2,000	3,270	Fir [Abies fabri], dragon spruce [Picea asperata], China fir, Pinus armandi, birch, oaks, mountain poplar [Populus davidiana] and paulownia
II Qing Jiang Forest Zone	1,000	1,062.9	China fir, massoon pine, Pinus armandi
III Juzhang He Forest Zone	300	625	Massoon pine, oaks
IV Mufu Shan Forest Zone	209	444.3	China fir, Castanopsis sclerophylla, massoon pine and moso bamboo
V Dabie Shan Forest Zone	303	1,050	Massoon pine, China fir, bamboo
VI Dahong Shan Forest Zone	150	756.8	Massoon pine, oaks

There are an estimated more than 1,300 varieties of trees in the province, almost half of which are in timber forests. The trees most used in construction are massoon pine, oak, Chinese fir, Pinus armandi, Chinese pine [Pinus tabulaeformis], cypress, fir, mountain popular and moso bamboo. Forest resources are especially plentiful in western Hubei where there are numerous varieties of trees, many of which have a high economic value. There are also small numbers of valuable timber trees including needle leaf trees such as Pseudolarix amabilis, lacebark pine, metasequoia, Taiwana florisiana, yellow fir [7806 2619], taxus, Keteleeria davidiana, suihua fir [4482 5363 2619], and gingko. Deciduous tree varieties include aromatic fruit tree [7449 2654 2885], nanmu [Phoebe nanmu], sassafrass, Chinese tulip tree, and Houban chestnut [3729 2647 2698]. Metasequoias are a rapidly growing timber tree species that are rare in the world and that are a legacy of the Cretaceous Period in the Mesozoic Era of more than 100 million years ago. They have been termed "living fossils," that exist today only in western Hubei Province in a 600 square kilometer area in a line running through Xiaohe, Xhuishanba, and Moudao in Lichuan County. Here there are more than 5,400 trees with a girth of more than 20 centimeters, and more than 2,000 trees with a girth of more than 40 centimeters. The two largest trees are more than 400 years old and have girths of 2.3 and 2.23 centimeters, and heights of 35 and 36 meters respectively. They are the largest extant metasequoias in the world. Since the founding of the People's Republic, these metasequoias have become mother trees that provide seeds, several hundred to 1,000 jin of seeds being harvested annually. In 1977, a maximum of 1,800 jin of seeds was harvested. These trees provide seed stock to fraternal Chinese provinces and to more than 50 countries in the world for the growing of metasequoias.

In Hubei Province, the Shennongjia Forest Zone markets the transition belt for vegetation cover between east and west and north and south China. There are more than 2,000 varieties of vegetation cover in this area, which has been termed a "natural botanical garden." This is one of the country's important primeval forest zones.

Shennongjia's forest resources are extremely abundant, its medium age and mature forest resources amounting to 23 percent of total medium age and mature forest reserves in the province. This zone also has an approximately 70 percent forest cover rate. The pattern of distribution of forest plants is characterized by marked vertical belts. In the region below 1,000 meters above sea level, economic forest belts with tung oil, eucommia, and walnut [Juglans regia] predominate. The region from the foothills to 1,700 meters above sea level is one of evergreen broadleaf and deciduous broadleaf forests in which grow primarily cork, mao chestnut [5403 2698], Quercus serrata, nanmu, xie [2750], qingxian willow [7230 6929 2692], paulownia and Hubei Chinese ash, as well as massoon pine and Chinese fir trees. The area between 1,700 meters and 2,300 meters above sea level is one in which luminiscent needle leaf trees and deciduous broad leaf trees grow. Principal tree varieties include Enshi beech, sharp toothed oak [6904 7876 2929], and Pinus armandi. In areas above 2,300 meters, as the elevation above sea level increases, the climate becomes colder and wetter, making this the forest area where dark needle leaf trees, mostly Bashan firs and red birches [Betula albo-sinensis] grow. The forest regions also contain rare trees in numbers seldom found elsewhere

including category 1 and 2 rare trees protected by national regulations such as the influorescent and especially beautiful and dove white, world-renowned tree, the Davidia involucrata, as well as aromatic fruit trees, maidiao firs [7796 0680 2619] (also known as dropping limb dragon spruce), nanmu and yellow firs. Tree varieties rarely found elsewhere in the world of important scientific value are also found here including shuiqing trees [3055 7230 2885], and lianxian trees [6647 7449 2885]. There are also rare varieties of timber trees whose wood is very hard and of superior quality such as zijing [4793 5449] (also known as maliuguang [7456 3296 0342]), daquoqing-qian [1129 2654 7230 8422], Chinese littleleaf box, badongmulian [1572 2767 2606 5570], lingchunmu [7325 2797 2606], smooth barkbirch [Betuila lumini-fera], white bark pine, qiye tree [0003 0673 2885], walnut, Liriodandron Chinese and kutao [5388 2711].

Diversified economic forests containing tea oil, tung oil, Chinese tallow, lacquer, citrus, apple, walnut, Chinese chestnut, persimmon, date, peach and plum trees are also widely distributed in the mountain and hill regions of the province. In plains lake regions, in hill regions and in the "four besides," numerous varieties of trees may also be found. Frequently seen timber tree varieties include Chinese ash, chinaberry, dryland willow [Salix matsudana], paulownia, fatong [3127 2717], Chinese parasol tree, Chinese toon, the tree of heaven, elm, glossy privet, camphor and cypress, as well as metasequoia and Taxodium ascendens introduced from elsewhere. These ever-green, deciduous, needle leaf and broadleaf tree varieties are distributed in different areas to lend a gorgeous character to the province's forest resources.

(2) Timber Forest Resources

Hubei Province's forest area and forest reserves are both lower than world and national standards (see Table 1-18). As compared with several neighboring provinces, Hubei Province's forest area is only 57 percent that of Hunan, 28 percent that of Shaanxi, and 53 percent that of Jiangxi. Forest reserves are only 30 percent that of Hunan, 25 percent that of Shaanxi and 54 percent that of Jiangxi. In terms of population, the province averages only 1.3 mu of forest per capita, which is only 10.8 percent of the world average (which is 12 mu), and 65 percent of the national average (which is 2 mu). Timber reserves average 2 cubic meters per capita for the province as a whole. This is only 2.4 percent of the work per capita average of 83 cubic meters, and 18.9 percent of the national average per capita of 10.6 cubic meters. For this reason, positive action must be taken for vigorous planting of trees in afforestation in order to expand the forest area rapidly, to increase forest reserves, and to catch up with national and foreign levels. (See Figure 10, Map Showing Distribution of Forest Resources in Hubei Province) [This map, Figure 10, missing in original text]

Table 1-18 Distribution of Hubei's Forest Area and Reserves

Units: 10,000 mu; 10,000 cubic meters

Prefecture	Live timber reserves	Existing forests		Young forests		Middle-age forests		Mature forests		Sparse forest area	Dispersed reserves
		Area	Reserves	Area	Reserves	Area	Reserves	Area	Reserves		
Total	9,239.8	5,657.7	8,019.0	3,948.3	1,649.0	1,156.9	3,330.7	572.2	3,038.2	730.5	490.4
Huanggang	980.1	783.2	917.5	596.2	320.1	179.9	562.9	7.0	34.4	18.5	44.0
Xiaogan	150.3	319.5	108.9	299.1	58.0	17.0	39.1	3.4	11.8	37.2	4.1
Xianning	454.0	362.1	385.7	273.5	160.6	86.5	214.6	2.5	10.5	27.7	40.4
Jingzhou	541.9	346.5	366.8	288.6	145.9	62.5	161.3	15.4	59.5	144.1	30.9
Xiangyang	1,030.1	993.3	905.4	739.3	261.2	207.5	450.9	46.4	193.2	79.5	45.7
Yunyang	1,331.8	792.6	1,243.6	546.8	219.3	120.5	405.5	125.3	618.7	19.7	68.4
Yichang	1,376.7	950.1	1,140.8	719.6	171.3	122.7	412.7	107.6	556.7	74.3	161.5
Enshi	1,657.6	746.4	1,324.9	359.0	215.2	297.6	780.6	89.7	329.1	269.5	63.0
Shennongjia	1,554.0	241.5	1,478.6	25.8	36.6	50.0	260.3	165.7	1,181.7	54.8	21.0
Shiyan City	123.0	60.4	111.2	42.9	41.3	8.2	27.1	9.2	42.6	4.5	7.3
Wuhan City	17.8	32.9	15.5	29.9	4.9	3.0	10.5			0.2	2.1
Huangshi City	22.5	29.2	19.9	27.6	14.6	1.5	5.2	0.005	0.003	0.5	2.0

Hubei Province's timber forest resources have the following several characteristics:

1. Little Mature Timber and a Heavy Proportion of Immature Timber

The province's existing forest resources include only 5,722,000 mu of mature timber, which is only 10.1 percent of the total timber forest area. Timber reserves amount to only 30,382,000 cubic meters, which is only 37.9 percent of total reserves. However, the area and volume of immature resources (middle age and young forests) and are 89.9 and 62.1 percent respectively, which is much more than the mature timber forest area or volume of timber.

Extrapolation from the province's present annual amount of timber consumption shows that the present amount of timber forests can supply only enough timber for 10-odd years, and that the total area of middle age forests will suffice for only between 10 and 20 years. By the end of this century, the province will have to use the second group of backup resources. Therefore, it is necessary to start right now to make sure of good management of existing young forests, to intensify care and management, to strive to increase yields per unit of area, to bring about early maturity, to persevere in a program of "taking forest management as the basis, linking felling and growth, carrying on afforestation and management simultaneously, and using forests in multiple ways" with energetic planting of trees for afforestation so that "the more felling, the more trees there are, the more felling, the better the trees, the green mountains always remaining and continuing to be used forever."

2. Relative Concentration in Distribution of Mature Forest Resources

Distribution of mature forest resources in Hubei Province. The Shennongjia Forest Area has 38.9 percent of the province's forests, Xinyang Prefecture 20.3 percent, Yichang Prefecture 18.3 percent, Enshi Prefecture 10.8 percent, and five other prefectures a total of 11.7 percent. This demonstrates that close to 90 percent of usable, mature forest resources are concentrated in the province's western mountain regions, particularly in remote areas where the mountains are high, population scant, and transportation poorly developed.

3. Massoon Pine and Various Kinds of Oak Are Major Tree Varieties

The province's timber forests consist mostly of massoon pine and various kinds of oaks, both in terms of area (including the area in all age groups) and reserves. (see Table 1-19)

In a 56,578,000 mu timber forest area, massoon pine accounts for 54.9 percent and oaks for 31.4 percent, the two totaling 86.3 percent. Massoon pine also accounts for 42.4 percent of the province's 80.19 million cubic meters of timber reserves, and oak varieties for 41.8 percent, the two accounting for 84.2 percent of the total. Clearly these two tree species hold an absolute position of superiority in the province's timber resources. This will be even more the case in the future inasmuch as in young tree areas, these two varieties of trees currently account for 88 and 93 percent of the total. Massoon pine accounts for 59.8 percent of the young tree forests and for 74 percent of

Table 1-19 Hubei Province's Major Timber Growing Areas and Reserves

Units: 10,000 mu; 10,000 cubic meters

(a) 树种	(b) 面积				(g) 蓄积			
	(c) 合计	(d) 幼龄林	(e) 中龄林	(f) 成熟林	(c) 合计	(d) 幼龄林	(e) 中龄林	(f) 成熟林
Total	5,657.8	3,928.3	1,157.0	572.0	8,019.1	1,649.2	3,330.9	3,038.3
Massoon pine	3,109.5	2,350.8	669.6	89.0	3,400.1	1,221.6	1,842.6	335.8
Oak varieties	1,777.2	1,107.7	291.7	377.8	3,356.1	316.4	932.1	2,107.4
Chinese fir	460.4	294.1	147.1	19.2	528.6	56.2	403.8	68.6
Pinus armandi	106.5	47.8	18.6	39.9	326.1	14.3	75.0	236.7
Mountain poplar	123.9	70.9	17.5	35.4	245.5	27.3	51.2	166.9
Cypress	69.9	56.1	12.1	1.6	38.2	13.3	21.1	3.7
Fir	10.4	0.9	0.4	9.1	124.5	0.1	5.1	119.2

Key:
a. Tree specie
b. Area
c. Total
d. Young forests
e. Middle age forests
f. Mature forests
g. Reserves

reserves. Thus, in the future, each jurisdiction will have to intensify care and management of young forests, and devote particular attention to care and management of massoon pines, and to prevention and control of pine moth.

(3) Economic Forest Resources

Hubei Province's major economic forests have two features (see Table 1-20) as follows:

1. Numeous Species and Small Quantity

The province's economic forests contain numerous varieties of trees. Major food and oil-bearing varieties include tea oil, walnut, Chinese tallow, tung, date, persimmon and Chinese chestnut, plus olive trees imported into China from elsewhere in 1964. Major tree species in special economic forests include lacquer, eucommia, gallnut, and mountain pepper trees. Other economic forests contain wood fungus bearing trees, tea, fruit, palm, mulberry and official magnolia [Magnolia officinalis] trees. Of the foregoing various kinds of economic forests, except for wood fungus bearing, lacquer, Chinese tallow, tung, and mulberry, which have a certain position nationally, the proportion of most of the other economic forest resources is very small. For example, tea oil trees account for only 6 percent of the forested area nationally, and accounted for only 1.3 percent of seed output in 1977. For others such as walnut, Chinese chestnut and persimmon, the proportion is even

Table 1-20 Area and Output of Major Economic Forests in Hubei Province (1978 Statistics)

Units: 10,000 mu; 10,000 dan

Prefecture	Tea oil		Tung		Chinese tallow		Walnut		Lacquer		Olive		Chinese chestnut		Eucommia		Palm		Official magnolia		(a)	(b)	(c)
	(d)	(e)	(d)	(e)	(d)	(e)	(d)	(e)	(d)	(e)	(d)	(e)	(d)	(e)	(d)	(d)	(d)	(e)	(d)	(e)			
Total	229.9	11.03	184.3	64.81	51.7	29.9	29.45	1.9	137.4	0.68	10.84		0.59	5.2	0.03		10.90	4.6	0.2177		1.0	1.9	2.98
Huanggang	63.1	2.07	10.3		10.0		0.01		4.2		2.0												
Xiaogan	12.3	0.04	2.9		3.5		0.01		0.4		1.33				0.0066								
Xianning	39.0	4.58	3.0		0.4		0.07		0.3		0.64												
Jingzhou	7.3	0.14	11.8		4.3		0.03		0.7		1.18												
Xiangyang	17.2	0.09	10.0		4.5		2.58		1.5		0.43												
Yunyang	21.9	0.63	71.5		3.4		20.0		57.6		0.66												
Yichang	19.3	0.23	28.2		15.6		4.92		14.0		1.46		0.43				8.10						
Enshi	45.5	3.07	41.0		10.0		1.83		58.0		1.26		0.02		0.0235		2.80		0.2177				
Wuhan	0.7	0.06	0.3								1.30				0.0001								
Huangshi	3.0	0.12	0.3						0.20		0.08												
Shiyan City	0.6		5.0						0.50		0.50												
Shennongjia													0.14										

Data lacking on eucommia bark and official magnolia bark output in Shennongjia

Key: a. Chinese gallnut output b. Black wood fungus output c. Cork output

smaller being .05 percent nationally. Output of some varieties such as tung, tea oil, Chinese tallow, walnut, Chinese chestnut, gallnut, black wood fungus, and lacquer has reached the level immediately following Liberation or the level of the all-time high year.

2. Concentrated Production Area

In Hubei Province, economic forests are usually concentrated in several counties. Lacquer forests, for example, are virtually all concentrated in Zhuqi, Luchuan, Xianfeng, Enshi and Jianshi Counties. Mulberry trees are concentrated mostly in Luotian, Macheng, Yingshan, Junxian, Suixian and Nanzhang Counties. Oak trees grow mostly in Junxian County. Most Chinese chestnut trees are concentrated in Luotian, Macheng, Enshi and Badong Counties. Most walnut trees are in Xingshan, Nanzhang and Fangxian Counties. Eucommia bark and official magnolia bark are produced largely in the Shennongjia Forest Zone and in Xingshan County. Most wood fungus production is concentrated in a band running through Baokang, Fangxian, Gucheng and Yunxian Counties. In addition, numerous economic forests are relatively concentrated. More than half the tea oil area and one-third of the tea oil output is concentrated in Macheng, Jinchun, Tongshan, Tongcheng, Yangxin and the Laifang Tujia Nationality Autonomous County, as well as in Xianfeng and Enshi Counties. Chinese tallow trees grow mostly in Luotian, Yingshan, Macheng and Dawu Counties in the Dabie Shan, and in Yichang, Changyang and Yidu Counties in southwestern Hubei. Tung trees grow mostly in Enshi and Yunyang Prefectures in western Hubei.

(4) Bamboo Forest Resources

The province's bamboo forest area totals about 1.09 million mu. Major varieties are moso bamboo, gui [2710] bamboo, Japanese timber bamboo [Phyllostachys bambusoides], Sinocalmus affinis [bamboo] [Phyllostachys congesta [bamboo], and hao [5548] bamboo, moso bamboo predominating with 912,500 mu and reserves of 92,639,500 plants as of 1977. Moso bamboo resources are concentrated mostly in Xianning Prefecture (an area of 651,300 mu and reserves of 61,734,800 plants), which is 71.3 percent of the total moso bamboo area in the province, and 66.6 percent of the reserves. Next is Huanggang Prefecture with 12.3 percent of the province's total moso bamboo area and 18.5 percent of reserves. Counties in which the bamboo forest area is more than 100,000 mu and reserves of more than 10 million plants include Tongshan, Chongyang, Puqi, Xianning and Yangxin. Nevertheless, Hubei Province's bamboo forest resources are very small in comparison with the country as a whole. For example, there are only 20 million bamboo plants having a girth of 5-10 centimeters and above growing on only 450,000 mu in the province. This is only 1.5 percent of the national bamboo growing area, and 3 percent of the total number of bamboo plants.

2. Wild Plant Resources

Hubei Province has abundant wild plant resources, numbering more than 1,000 varieties. They may be differentiated as wild oil-bearing plants, wild fiber plant, wild starch plants, wild chemical industry raw materials plants, wild medicinal plants, and wild livestock fodder plants according to the different uses to which they are put.

(1) Wild Oil-bearing Plants

Hubei Province has about 280 varieties of wild oil-bearing plants. Varieties having a fairly high oil content are fairly abundant numbering 10-odd. Examples include the fruit of the cubeb listea tree in Enshi, Yichang and Xianning Prefectures. (The cubeb listea oil steamed from this fruit is an important aromatic oil used in making various light industrial products.) The Cinnamomun partenoxylon, huoma [3499 7802], lacquer trees, Pinus armandi, hongfu poplar [4767 9690 2799], nanmu tree and Chinese pistache trees of the western mountain region of Hubei, the zhuangma [2866 7802] that grows in the area of Jingzhou, Yichang, Xiaogan and Xiangyang, plus the achene of Siberian cocklebur, the Chinese parasol trees, the wild Sichuan pepper trees and the camphor trees produce seeds from which oils are extracted for the making of soap, grease, printing ink and lacquer). In addition, a woody oil-bearing tree that grows mostly in the mountains of southwestern Hubei is the large-leaved dogwood [Cornus macrophylla], whose seeds contain 20-30 percent oil, which is used not only in industry but is also a fine edible oil. This tree is very adaptable, lives long and produces large yields of seeds. Its introduction to the province's mountain regions should be vigorously promoted.

(2) Wild Fiber Plants

The province has fairly plentiful wild fiber plants, with large quantities of more than 160 species of high utility. Reeds that grow widely along both banks of the Chang Jiang and in plains lake regions are a principal raw material for the making of paper in Hubei Province. Large reserves of bamaogan [5359 5403 2616] and Broussonetia papyifera trees also exist, and are a supplementary source of raw materials for the making of paper in the province. Bamaogan is produced mostly in Tongshan, Tongcheng, Chongyang, Yangxin, Xianning, Puqi, Luotian, Jinchun and Macheng Counties. The amount available in the province has been estimated at several hundred thousand tons. At the present time the state purchases only about 50,000 tons annually, so a very great potential exists. Broussonetia papyifera trees grow mostly in the mountain regions of western Hubei, and the state annually purchases between 70,000 and 80,000 tons. The bark of the Huanggou [7806 2845] tree, which is produced mostly in Enshi, Yichang and Yunyang Prefectures, and jinyaodai [6855 5212 1601], which is produced in an approximately 2,000 meter wide belt in the high mountains of western Hubei are raw materials for the manufacture of wax paper and typewriter paper. Kushu vines [5388 2885 5671], Celastrus orbiculatus, xiaogou tree [1420 2845 2885], and wild ramie are raw materials for the production of high quality textiles. Furong hemp [5346 554 7802], gexian hemp [4095 4960 7802], wild kudzu vine and tong hemp [2717 7802] are raw materials for the textile industry (to make cotton and woven gunny sacks), as well as to make rope.

(3) Wild Starch-Producing Plants

Hubei Province has more than 100 species of wild starch producing plants. These include oak acorns, brake [fern] root, kudzu vine, tielingjiao [6993 5480 6037], and the fruit of chinaberry, which have a high starch content, are produced in fairly large quantities, and may be used for a variety of purposes.

Acorns may be found throughout the province, but are most highly concentrated in Suixian, Baokang, Nanzhang, Fangxian, Junxian, Jingmen, Zhongxiang, Jingshan, Luotian, Dawu, Yingshan and Badong Counties where output reaches 300,000 tons, of which only between 6,000 and 7,000 tons are currently used. Formerly acorns were used mostly in the fermentation of alcoholic beverages, but in recent years they have come to be used to make starch sizing the quality of which is better than that of sizing made from grain. Brake [fern] root and kudzu vines grow mostly in southwestern and southeastern Hubei. Tielingjiao [6993 5480 6037], which is used in the fermentation of alcoholic beverages, is distributed in the mountain and hill regions of the province where probably more than 20,000 tons is available. However, since it is difficult to crack only about 200 tons is used. Chinaberries are produced mostly in northern, central and eastern Hubei. Output is about 50,000 tons annually. They are largely used today in the fermentation of alcoholic beverages and for the pressing of oil (their oil can be used industrially); however, since they do not make very flavorful alcoholic beverages and since their oil output rate is not high, they have not been fully used.

(4) Wild Chemical Industry Raw Materials

The province has numerous kinds of wild raw materials for industrial use, but not many of them have major economic value. Xiangwan [2895 4297], huaguo [5363 5470], and root of red rooted salvia [Salvia miltorrhizia] are used as raw materials in the tanning industry. In the production of leather, printing and dyeing, organic chemical raw materials such as Chinese gallnut are used. Gleditsia sinensis is used as a raw material in the manufacture of synthetic lates and agricultural pesticides. About 15,000 tons of xiangwan, (the fruit of the huali tree [5363 2929 2885], and the outer husk of acorns] is produced annually. It is used only to make tannin extract, but the residue that remains may also be used in multiple ways. Huaguo (the fruit produced by the huanxiang [2255 7449] tree) is produced in Macheng, Hongan, Luotian, Dawu, Yingshan, Suixian, Zhongxiang, Yichang and Enshi Counties. Output is about 1,000 tons annually. Red rooted salvia is scattered mostly in the high mountain region of southwestern Hubei. Between 1,000 and 1,500 tons are produced annually. Chinese gallnuts are produced in Xunyang, Enshi and Yichang Prefectures. The state annually purchases between 6,000 and 7,000 tons of them. Zaojiao is produced mostly in Yingshan, Luotian, Yingshan, Suixian, Nanzhang, Xiangyang, Zhongxiang, Jingmen, Yidu and Yichang Counties.

(5) Wild Plants Used for Medicinal Purposes

Hubei Province has a plentiful supply of wild plants used in medicine. At the present time, more than 500 varieties of herbs are gathered to make Chinese medicines. Those with most value include tuber of elevated gastrodia [Gastrodia elata], Chinese angelica, rhizome of Chinese goldthread [Coptis chinensis], Heracleum hemsleyanum, Luygodium japonicum, root of three-nerved spicebush [Lindera strychnifolia], papaya, teasel root, root of purple-flowered peucedanum [Peucedanum decursivium], Wuyu [0702 5341], huanggou [7806 2845], rhizome of Chinese atractylodes [Atractylodes chinensis], Cheqian [6508 0467], Asiatic plantain [Plantago asiatica], Schizonepeta tenuifolia, root of ballonflower [Platycodon gradiflorum], Tiandong [1131 0392], root of straight ladybell [Adenophora stricta], plus jiangbian yiwanshui [3068 6708 0001 4297 3055],

touding yikezhu [7333 7307 0001 7341 3796], qiyue yizhihua [0003 2588 0001 2655 5363], and kouziqi [2049 1311 0003]. Quite a few wild herbs have been brought under cultivation. Most of these medicinal materials are concentrated in the province's western mountains and grow particularly over the hills and dales of the Shennongjia forest region. This is a natural treasury for wild growing medicinal plants in the province that holds great prospects for future development. The famous "fangdang" [2075 3981] and the jiangbian yiwanshui, touding yikezhu and kouziqi are herbs peculiar to this area.

(6) Other Wild Plants

The province has more than 300 varieties of wild plants suitable for cattle fodder. This includes pasture grasses such as wild oats, verbena, dog's tooth grass [Cynodon dactylon], paspalum, agropyron, digitaria and wild alfalfa and forage for livestock such as wild chrysanthemum roots, the leaves of Broussonetia papyrifera, hosta ventricosa, wild three-colored amaranth, shepherd's purse, suanmo [6808 2875], Rumex crispus, cheqian, yinianpeng [0001 1628 5570], acanthaceous indigo [Strobilanthes cusia], Azora pinnata, salvinia [Salvinia natans], and water hyacinths. Not only are there large amounts, but they are found over a wide area.

Additionally, the province has numerous plants that provide materials for plaiting, such as branches of the five-leaf chaste tree [Vitex negundo], willow branches, and qingteng [7230 5671]. It has quite a few wild fruits such as Chinese yangtao [Actinidia chinensis], huoji [3499 2765], wild grapes, date palm [Diospyrsos lotus] fruit, wild Chinese hawthorn, and maoli [3029 2698]. Particularly noteworthy is the Chinese yangtao, which is a wild fruit peculiar to China that is rich in nutrients such as vitamin C, containing between 100 and 420 milligrams of vitamin C per 100 grams of fresh juice. This is between several times and more than 10 times more than from most fruits and vegetables. It is of very high economic value. This fruit is found widely throughout the province's mountain areas, and fruit output is at least more than 10 million jin annually. This is a food industry raw material with great potential that merits serious attention.

Development of the province's wild plant resources is currently still in a preliminary stage. Simultaneous with future vigorous efforts to survey resources, to protect them, and to sell them should be an exploration of new ways in which to use the resources, and active development of their use in multiple ways so that the province's wild plant resources will be more fully developed for use.

3. Wild Animal Resources

Hubei Province has fairly abundant wild animal resources. Except for a small number that live in rivers and lakes, most live in mountain and forest areas. Frequently seen wild animals include leopards, wild boars, badgers, elk, muntjacs, river deer, jackals, Mongolian gazelles, xiangli [7449 3706], Jiujiang panthers, crab-eating mongooses, raccoon dogs, otters, squirrels, foxes, panthers and European hares, plus ground birds [0966 7680], jin birds [6930 7680], and mountain birds [1472 7680]. In the Shennongjia forest area

of northwestern Hubei, wild animals are even more plentiful. Here the wild animal families are of the East China Sea region type, and species tend to be like those of semitropical areas of the south as well as of central and southwestern China. In addition, certain species are peculiar to the Shennongjia forest area or are relics of the Tertiary Period. Wild animals that have been discovered include many kinds of primate relics from ancient times (such as macaques, Sichuan monkeys, Macasa speciosus, and golden monkeys), Shennong white bears, wild oxen and rare animals such as serows, Panthers purdus, otters and wild boars, black bears, jackals [Cuons javanicus], raccoon dogs, foxes, weasels, sand badgers, tigers, leopards, and gorals [Naemorheaus goral]. The most abundant animals are serows, river deer, small deer [1420 7774], large deer [1129 7774], xiaolingmao [1420 7227 3728], masked civets, clouded leopards, ferret badgers and porcupines. There are also species of animals found in north China such as roe deer [Capreolus capreolus], Chinese zokors and flying squirrels [Trogopterus xanthipes]. Particularly noteworthy and reported both in historical records and by the local people is the existence of a strange animal in the Shenongjia forest zone--"wild man." Eyewitness accounts of this strange animal report the following features: a body height of about 2 meters, brown hair covering the entire body, long hair hanging down to the shoulders, a large mouth, narrow face, a head shaped like a horse's chest, a human form and walking upright on two legs. Efforts have been made to study this creature, but none has been captured. According to the Institute of Vertebrate Palaeontology and Palaeoanthropology of the Chinese Academy of Sciences, preliminary analysis of body hair and head hair and footprints suggests that the Shennongjia "wild man" may be a kind of primate that is taller than an orangutan and walks on two legs.

Bird species are also extremely abundant in the Shennongjia forest region. There are red breasted jin birds [4767 5215 6930 7680], Pucrasia macrolopha xanthospila, tragopans and such central China types. There are also mynas reminiscent of the subtropics, Beijing nightingales [Leiothrix lutea], babbles [Garrulax canorus], black faced laughing thrushes, and white cheeked laughing thrushes. At high elevations above sea level, there are also species found in north China in ancient times as well as chafu crows [5420 5215 7693], jays [Garrulus glandarius] and xing crows [2502 7693].

4. Aquatic Product Resources

(1) Fish Resources

Hubei Province is crisscrossed with rivers and dotted with lakes. It is known as "the land of fish and rice." In addition, following liberation numerous reservoirs and dammed ponds were built. These bodies of water, when taken together with the temperate climate, and the abundance of natural food for aquatic animals provide a suitable place for fish to live. As a result, the waters of the province are haunts for different species of fish from the upper and lower reaches of the Chang Jiang and contain numerous natural varieties of fish. This provides extraordinarily superior conditions for the development of a freshwater fishing industry, and Hubei is one of the main freshwater fish producing areas in the country. The waters of the Chang Jiang within the borders of Hubei Province contain 136 kinds of fish, which is half the total kinds of fish (274 varieties) found throughout the Chang Jiang water system.

In Hubei Province, fish of the Cyprinidae [carp] family predominate accounting for 58 percent of the total number. Second is members of the Serranidae [eel] family, accounting for about 8 percent. Others include members of the Leiocassia family and the Gobiidae family. Their areas of distribution by bodies of water are detailed below.

1. Fish in the gorges section of the Chang Jiang

The section of the Chang Jiang from its point of entry into Hubei from Sichuan Province to the gorges covers a distance of 140 kilometers and marks the end of the upper reaches of the Chang Jiang. Because of the peculiar geographical conditions, the varieties of fish found in this section of the river are a mixture of those found in the upper reaches of the Chang Jiang and in the plains areas of the Chang Jiang and the Huai Jiang. In addition to fish found over a wide area such as snail carp, grass carp, silver carp, bream, Culter albernus, Coreius, Glyptosternum reticulatum, and Hemiculter leucisculus, there are two types of fish that inhabit different habitats. One has its habitat above Yichang and is a fish suited to life in a fast moving current. This type includes Chinese qiexiong zhao [0434 5172 7625/0340], and Procypris rabaudi. The other type has its habitat below Yichang and is suited to life in a slow moving lake environment.

This includes Coilia bachygnethus, ni fish [6627 7625], Mustacembelus, and gan fish [7625/1949 7625]. The two kinds of fish that live in these two different ecological environments intermingle in this area, enriching the varieties of fish distributed in the gorges area above Yichang.

In addition, in the gorges are numerous reefs, deep pools, shoals and a swift current. When parent fish go upstream, they are frequently blocked below the Su Shoals and the Qing Shoals where they spawn every spring and summer. Thus the stretch between Letian Creek and Shilihong at Yichang has become the largest natural spawning ground for fish--the famed Yichang spawning grounds.

2. Fish in the plains section of the Chang Jiang

The plains section of the Chang Jiang lies below Yichang extending a distance of about 1,000 kilometers to the mouth of Jiangxi Hu near Huangmei. In this section lies 87 percent of that portion of the Chang Jiang that flows through Hubei Province. This section of the river is broad and the waters move slowly. Numerous lakes stretch along both banks and the waters are rich in food for aquatic animals making them most suitable for fish to live in. The monsoon winds which produce flood waters every year favor the reproduction of domesticated fish. Most of the fish are kinds that live in schools in slow river currents and in lake environments such as snail carp, grass carp, silver carp and bighead carp. However, marked differences occur in the reaches above and below Chenglingfan.

The Jing Jiang section (the section from the west of Chenglingfan to Yichang). Here there are numerous bends, shoals and islets in the river around which the water flows slowly, where rushes grow in profusion and where there is silt and a proliferation of living creatures that aquatic animals eat. This is a first

rate feeding ground for fish. Close by the low mountains on the southern shore deep pools frequently occur, which are habitats in which fish overwinter. Meizi Creek below Baiyang in Yidou County, for example, is the habitat of the valuable sturgeon. Bijiashan in Shishou County is a habitat for Leiocassis and is famous for producing "Bijia fish maw." The churning currents of river bends are spawning grounds for common carp and crucian carp, which produce sticky roe (there are more than 10 spawning sites here, and the section of the river in which spawning takes place extends for about 230 kilometers. Grass carp predominate, silver carp being second most numerous).

The down river section (east of Chenglingfan to the lake mouth section). Here the river is broad and bends are few. The waters of the Xiang, the Zi, the Yuan and the Li enter the Chang Jiang in this section, and the Hanshui forms a confluence with it. The volume of water rises abruptly; the flow is vast and mighty; and varieties of fish are extremely abundant. In addition to the kinds of fish that inhabit this section, migratory fish from down river such as Coilia ectenes and herring may be found. It is the province's major natural fishing ground.

On both banks of this section of the river, mountain crags protrude over the water; the waters are deep and the current turbulent. This is also the province's natural ground for the production of fingerlings. The spawning ground section of the river extends for more than 100 kilometers, which is about 19 percent of the length of this section of the river. Domesticated fish consist mostly of snail carp, with grass carp and silver carp being second, followed by crucian carp.

3. Kinds of fish in the middle and lower reaches of the Han Jiang

The Han Jiang enters the province from the northwest and cuts across the middle of the province. It has been a major producing area for fish and fingerlings in the province. The very great changes in hydrological conditions in the middle and lower reaches of the Han Jiang that followed construction of the Danjiangkou reservoir dams greatly affected the feeding, habitat, spawning and food supplies of fish. For example, in sections of the river in all the counties below the Danjiangkou Dam, mostly small bodied fish exist, with rhinogobio, saurogobio and Pseudobagrus fulvidraco predominating, while large fish such as snail carp are on the verge of extinction. As a result of the backing up of water into the Qian Jiang section of the lower reaches of the Hanshui, snail carp, grass carp, silver carp, bighead carp, culter albernus and common carp predominate. All of these are characteristic of the main stream of the Chang Jiang. Furthermore, in the middle reaches of the Han Jiang in the section around Xiangyang, the fish are both characteristic of the counties in the upper reaches and of the lower reaches in the Qian Jiang section. In addition, there are fish from the Tangbai He water system in Henan Province, such as Chinese qiexiongzhao. A noteworthy change is in the output of the Coreius cetopsis in the section of the river at Xiangjiang. Following completion of the Danjiangkou nexus, this breed increased. Statistics for the period May to July 1974 show that Coreius cetopsis accounted for 72.9 percent of total catches in the Zhangwan fishing grounds in Xiangyang, making them the principal fish. The reason awaits further investigation.

Following construction of the Danjiangkou Dam, the domesticated fish spawning grounds in the middle and lower reaches of the Han Jiang all but disappeared. New domesticated fish spawning grounds are in the process of being formed in the stretch of river between Xiangyang and Zhongxiang, but it is not very large in size and fingerling output is not great.

4. Natural lake fish

Hubei Province has more lakes than any other province in the country and is known as "the province of a thousand lakes." The water in the lakes is warm; its quality is good; water plants are numerous; plankton and creatures inhabiting the bottom are numerous and, in addition, each year all sorts of organic nutrient salts are brought into the lakes to provide a superior natural environment for the growth of fish.

There are more than 80 species of fish in the province's natural lakes, more than 30 of them common varieties such as snail carp, grass carp, silver carp, bighead carp, sidajia fish [0934 1129 1367 7625], common carp, crucian carp, and culter albernus as well as renowned fish such as Wuchang fish [Megalobrama amblycephala), Mandarin fish [Chinese perch], whitebait and chun fish [2504 7625].[1]

As a result of the severing of rivers from lakes, the travel to lakes of fingerlings is blocked. In addition, because of the decline in the water level of lakes and a shrinking of their size, catches of natural fish have declined markedly. Nevertheless, lakes still remain the major producing areas of economic fish in the province. Yields of fish reared in lakes reach as high as 100-odd jin per mu, but may fall as low as only 10-odd or even only a few jin. Clearly the potential for increased yields is very great.

(2) Other Aquatic Products

In addition to fish, Hubei Province has numerous kinds of aquatic plants and animals that can be used for food or that have substantial economic value.

1. Aquatic Plants

Lotus root. Lotus root is produced on the Jiangjan Plain and in the shallow lakes and dammed ponds of the province's southeastern hill region. In 1975, the province's lotus growing area covered about 230,000 mu (domesticated lotus on 20,000 mu of it). Most lotus growing was concentrated at Jianli, Honghu and Mianyang on the Jianghan Plain, which accounted for 68 percent of the province's lotus growing area. The Longwang lotus produced at Xinzhou has firm seeds, tender flesh and large seeds that are perfectly round, making it a fine variety of white lotus that is much sought internationally.

1. Megalobrama amblycephala live mostly southeast of Wuhan in deep lakes such as Liangzi Hu and Dong Hu. Chun fish live mostly in the Yangxin network lake area, and are a mountain creek fish.

Water chestnuts: Water chestnuts grow over a wide area in Hubei Province, most of them being grown in wetlands (in southern Xiaogan, they are frequently grown in lake fields and rotationally cropped with paddy rice). Water chestnuts from Wangdian in Dangxian County are the finest, being plump and crisp, sweet and delicious.

In addition, wild rice stems, gorgon fruit and caltrops are also major aquatic food plants grown in the lake regions of the province.

2. Aquatic Animals

Shrimp and crabs. Shrimp and crabs live in the rivers and lakes. Crab meat is delicious and very nutritious. In recent years, crab larvae have been imported from the mouth of the Chang Jiang into Hong Hu, Liangzi Hu, Xiliang Hu and Futou Hu in Hubei Province where they have been reared with very good results.

Mollusks and Gastropods. Large numbers of freshwater mollusks and gastropods make their habitat in the lakes of the Jianghan Plain where there are several score varieties. Frequently seen ones include lake clams, yellow Corbicula leana [7806 9223], lake snails and such soft bodied lake bottom creatures. Yangxin are the most numerous mollusks, with an output of 600,000 jin in 1975 followed by Tianmen with an output of 400,000 jin. Gross output for the province as a whole was 1.5 million jin. Not only can mollusks and gastropods be eaten, but some are also useful as industrial raw materials and as export items. In recent years, lake clams have been successfully used to produce pearls, and now more than 30 counties and cities have begun to produce pearls. A very great potential exists for multiple uses of mollusks and gastropods.

Wild ducks: Hong Hu is famous for wild ducks with an annual output of about 400,000 jin, and an all-time high output of more than 700,000 jin. It accounts for more than half the province's wild duck output.

In addition, Huanggang, Xianning, Jingzhou and Xiaogan Prefectures produce large numbers of tortoises and soft-shelled turtles that are used both as food and medicinally. The giant salamanders of the mountain valleys of western Hubei have a white and delicately flavored flesh, which is a valuable export product.

Chapter 2. Hubei Province's Agricultural Production and Achievements in Construction Since the Founding of the People's Republic

First Section. Marked Improvement in Agricultural Production Conditions

1. Harnessing Water and Improving Soil, Making Major Efforts in Capital Construction of Farmlands

Under the rule of the feudal landlord class, until the time of liberation, the province's farmland lay uncultivated, protective dikes were in disrepair, and flood and drought disasters occurred incessantly. Historical records show that during the century and a half between 1801 and 1949, 142 major and minor floods and 88 droughts had occurred. During the great flood of 1931, 27 million mu of farmland was inundated and more than 10 million people were disaster stricken, 80,000 of them perishing. Navigation of the Chang Jiang ceased and communications were cut off. Boats could ply the streets of Sanzhen in Wuhan and 780,000 people throughout the city were forced to flee their homes. Up until the time of liberation, there was not a single reservoir with a capacity of more than 1 million cubic meters in the entire province, much less any hydroelectric power stations or electrically powered irrigation and drainage stations. Farmland irrigation was completely dependent on the limited water resources found in natural rivers, lakes, small ponds and small dammed pools. The fairly large sluice gates built for drainage at several points along the Chang Jiang were also notoriously weak and produced very little benefit. In the farflung mountain regions, landslides occurred with each torrential rain and soil was scoured away destroying countless farmlands. Throughout the province, more than 50 million mu of farmland, or more than 90 percent, "looked to the heavens for the rains needed to bring a harvest." Agricultural production was extraordinarily backward.

The founding of New China ushered in a new era in the Chinese people's transformation of nature. The people of Hubei Province acted with the heroic spirit of "man can triumph over nature" to launch a great struggle on a grand and spectacular scale to "rearrange the mountains and rivers." They began with flood prevention, strengthening protective dikes, separating rivers and lakes, and closing off main portals to protect grain and cotton production bases. Then, in 1952, they began to build reservoirs in mountain and hill regions to impound water for irrigation. At the same time they opened canals and built floodgates in lake regions in an effort to remove waterlogging. After many years of integrated construction of these projects, they gradually formed a continuous whole, and many prefectures set up fairly extensive drainage and irrigation systems. (see Figure 11) Once the waters had been harnessed, they tackled improvement of the soil. In mountain regions, they renovated terraces, and in hills and plains regions they leveled the land and improved low yield fields, all with marked success. In recent years, as part of a mass movement of major capital construction of farmlands on the part of the people in the province, harnessing of water and improvement of soil have been closely linked. The harnessing of water and improvement of soil have been centerpieces for tackling problems concerning mountains, rivers, farmland,

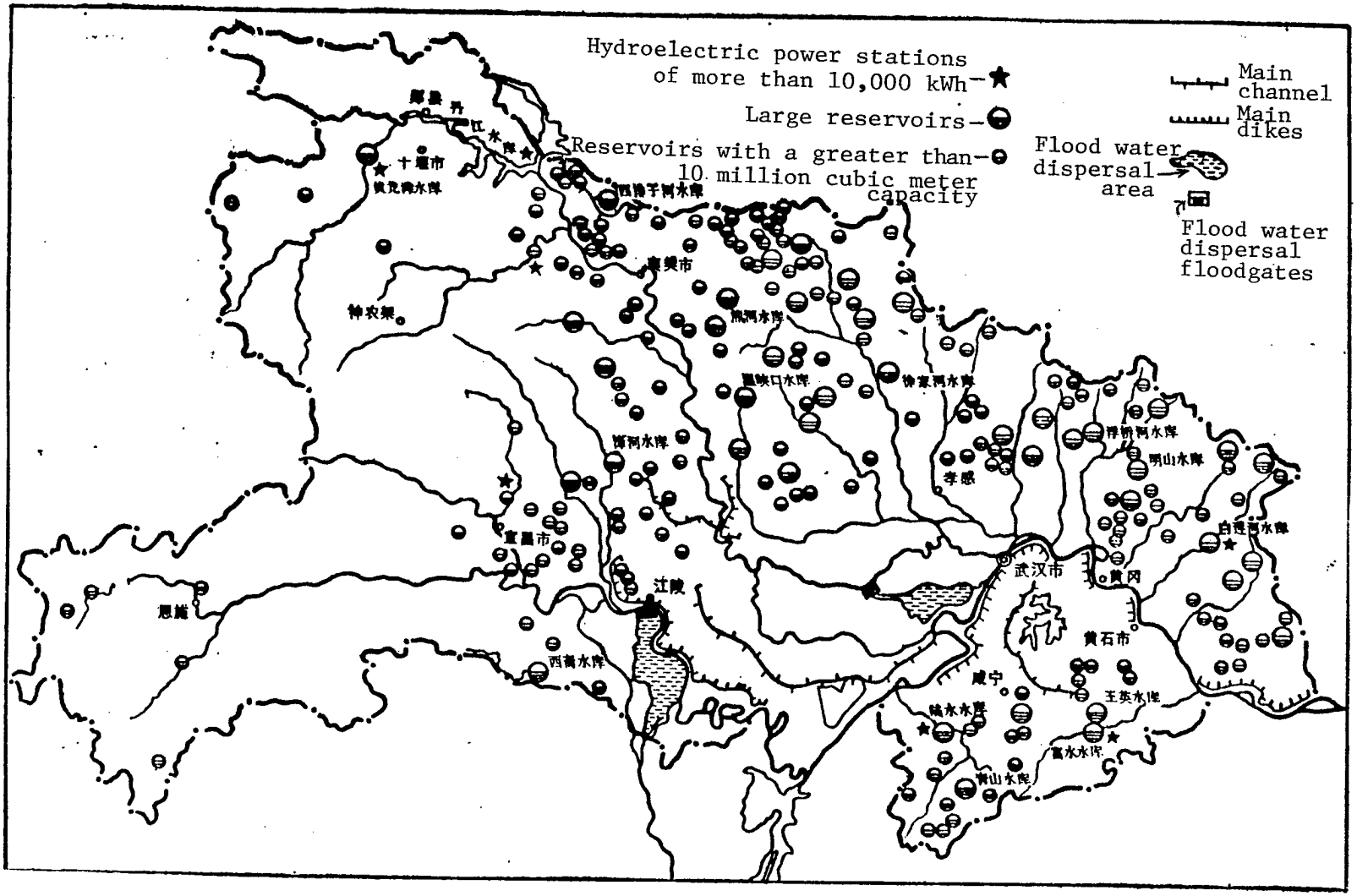

Figure 11. Finished Water Conservation Projects in Hubei Province

forests, and roads in a comprehensive way. The extent of farmland capital construction has become increasingly great, the speed of development ever faster, and the quality of projects ever higher. Thus a very great transformation has taken place in the province's agricultural production conditions.

(1) Building a Series of Large Flood Prevention Projects To Greatly Increase Flood Prevention Capabilities

During the past 30 years the people of Hubei Province have done the huge job of repairing and strengthening Chang Jiang and Hanshui dikes in order to prevent flood disasters. The great Jing Jiang dike is the most important section of dike along the Chang Jiang. It begins at Jiangling and travels eastward to Jianli, a distance of 182 kilometers. This dike protects more than 30,000 square kilometers of land on the Jianghan Plain, a 4 million population, and 8 million mu of cultivated land. This section of the river twists and turns and the current meanders slowly, resulting in serious silting and steady rise in the river bed. Each time the river floods, the lives and property of the people, as well as agricultural production on both banks of the river are in serious jeopardy. Since liberation, people's governments at all levels from the national to the local have been extremely watchful of this section of the river, and have many times organized the people who live along the river to make major renovations. During the past more than 20 years, the great Jing Jiang dike has been built 3 meters higher throughout its course, and widened 6 to 8 meters. In addition, stones have been thrown up to protect the shore for more than 50 kilometers. Hidden dangers have been removed at more than 100,000 different places along the dike. The dike has been built to withstand floodwaters as great as those of 1954. Simultaneous with the rebuilding, renovating and strengthening of the great Jing Jiang dike has been large scale strengthening of the Huang (Mei) and Guang (Ji) great dikes, and of the Wuhan municipal dike, the Huangshi municipal dike, the Siyi dike and the Han Jiang dike, as well as dikes along sections of other rivers. Large scale strengthening of dikes was done to withstand flooding of the Chang Jiang at the 1954 intensity, and of the Han Jiang at the 1964 intensity.

In addition to the rebuilding of dikes, huge water conservancy projects were continuously built to disperse the flood waters of the Jing Jiang, and the Dijiatai, and to divide up or store flood waters entering the Hong Hu so as to increase flood prevention capabilities and guard against exceptionally great flood disasters. When particularly large flood waters threatened large dikes and major cities and towns, flood gates could be opened or openings made to disperse the flood waters to insure the safety of key areas.

The project for dispersing flood waters of the Jing Jiang was the first large scale water conservancy undertaken in Hubei Province following liberation, with construction beginning in 1952. Located on the south bank of the Chang Jiang in Gongan County, the entire project included a 54 portal 1,054 meter-long emergency exit floodgate and a control gate at Huangshan, as well as a 200-kilometer dike encircling the flood area. More than 12 million cubic meters of soil and rock alone were moved to build the project. Chairman Mao was extremely concerned about the welfare of the people of Hubei, and personally penned the following: "Win victory with the Jing Jiang flood dispersal

project for the benefit of the broad masses of people." Inspired by the words of Chairman Mao, the several hundred thousand strong labor army that had a part in this project waged a war for 75 days for victorious completion of the entire project, and composed a victory song of self-reliance, arduous toil, and unity to control the waters. After the project was completed, particularly severe flooding of the Chang Jiang such as has rarely occurred in history occurred in 1954. Three times the floodgates of the Jing Jiang flood dispersal project had to be opened, and maximum volume of flood waters through the gates was more than 8,000 cubic meters per second. Total volume of the dispersed flood waters was more than 12 billion cubic meters. This lowered the water level around Sha City by about 1 meter and assured the safety of the great Jing Jiang and Wuhan dikes. In 1956, another flood water dispersal project was built at Dujiatai in the lower reaches of the Han Jiang. This project included a 412-meter long floodgate with 30 portals to permit entry of flood waters and a 20 kilometer long channel to disperse the flood waters. Maximum flood water dispersal capacity is 6,000 cubic meters per second, and total volume of flood water dispersal is 1.6 billion cubic meters. Following completion of this project, it was used numerous times to marked advantage in protecting the dikes in the lower reaches of the Han Jiang. Subsequently, a reclamation project to impound flood waters was built on Hong Hu with the capability of dispersing a total volume of 1.1 billion cubic meters of flood water.

By way of closing the main entry way, impeding flood waters, and draining away waterlogging, more than 2,000 culvert floodgates, large and small, were built along rivers to change river water reverse irrigation during flood season, and the inundation of floodwaters everywhere.

Additionally, in order to hasten the flood waters on their way through the twists and turns of the Jingmen river bed and help navigation, once the flood control projects were completed, the river channel was dredged. Since 1966, pilot projects have been undertaken to straighten the main channel of the Chang Jiang at Zhongzhouzi and Shangchewan. Once these two projects have been completed, they will have shortened the distance by 80 kilometers, increased the volume of flood waters discharged, and reduced the threat to the great Jing Jiang dike resulting from blockage of flood waters.

As a result of the efforts in various regards mentioned above, flood prevention capabilities of the Han Jiang dikes floods have been greatly increased, and 80 percent of the main dikes exceed standards for prevention of floods such as occurred in 1954 on the Chang Jiang and in 1964 on the Han Jiang.

(2) Construction of Large Numbers of Gravity Flow Drainage Projects and Electromechanical Drainage and Irrigation Stations To Reduce Disasters From Water Stagnation and Waterlogging

Mountains surround Hubei Province on the west, north and east, and rivers from the surrounding mountains converge on the Jianghan Plain. With the arrival of the rainy season, the rivers rise suddenly and water does not drain away easily. Waterlogging and stagnation calamities result. In the four lakes region (Chang Hu, San Hu, Bailu Hu and Hong Hu), which lie in a

triangular area between the Han Jiang and the Chang Jiang, in particular, the terrain is low (80 percent of the land lying between 6 and 10 meters below the level of the surrounding rivers), the lakes are close together, tributaries are numerous, and the water system is tumultuous. Here water calamities are more severe. For many years the people of the province have followed the principle of "drainage first, giving concurrent attention to drainage and impounding water, a combination of drainage and irrigation, draining water at different levels, and using gravity drainage primarily in combination with the lifting of water to drain the lowlands." They established a series of projects to drain waterlogging. To reduce damage from water stagnation in the plains lake region, they completed work on the main channel, eastern channel and western channel of the Tianguan He and the four lakes, plus a huge project to reverse the course of the Hanbei He in its lower reaches and change the river bed in the lower reaches of the Fu He in the building of a gravity flow drainage system. A more than 17 million mu water drainage area was brought under control, including an 11 million mu area that will meet conditions likely to be encountered during the next 5 to 10 years. This greatly reduced calamities resulting from waterlogging and water stagnation in the plains like area. In lowlying areas not amenable to gravity drainage, a number of stations were built for the mechanical lifting and drainage of water. As of 1978, electromechanical drainage and irrigation stations in the province existed at more than 11,000 places. They had an installed capacity of 1.67 million horsepower, were able to irrigate or drain at the rate of more than 3,800 cubic meters per second and drained and irrigated an 18.68 million mu area.

Linked to the draining of waterlogging was a large-scale project for the eradication of snails to prevent and control schistosomiasis. Snails were eradicated from a 1.33 million mu area throughout the province, or on 95 percent of the 1.4 million mu area (not including offshore shoals) on which oncomelania [the intermediate snail host of blood flukes] had lived.

(3) Configuration of an Irrigation Network Centering Around Reservoirs and Combining Impounding, Diversion and Lifting of Water for Gradual Control of Mountain Torrents and Soil Erosion as Well as To Provide Agriculture With Plentiful Supplies of Irrigation Water

By way of making fullest use of water conservancy resources and transforming water damage into water benefits, the province built large numbers of reservoirs and other projects for impounding, diverting and lifting water to configure a provincewide irrigation network based on medium and small size projects, with large-scale projects as mainstays.

In farflung mountain and hill regions, flood prevention and irrigation were of paramount importance in individual basins and the principle followed was multiple use of projects to prevent flooding, to provide irrigation, to generate electricity, to permit navigation, to raise aquatic products and to provide water for forestry and sideline occupations. Large and small reservoirs were built at more than 6,000 places, and more than 1 million dammed ponds were built or renovated. In addition, a large number of irrigation and drainage canals and water diversion projects were built. The building of

these projects both helped control mountain torrents and soil irrigation as well as eliminated the danger of flooding and waterlogging in the lower reaches. They increased the quantity of water for irrigation. They promoted development of hydroelectric power generation, the rearing of aquatic products and navigation. The large-scale pivotal Danjiangkou hydroelectric project is the largest pivotal water conservancy project in the province that is now substantially finished. It controls flooding by 20 billion cubic meters of water in the upper reaches of the Han Jiang, thereby greatly reducing flood cresting in the middle and lower reaches of the river. Its large amounts of electricity are transmitted to a broad area in northern, western and eastern Hubei as well as to the Jianghan Plain and to Henan Province to give powerful impetus to development of industrial and agricultural production. Its huge water surface and the stream of water discharged after having generated electricity have improved conditions for navigation and the raising of aquatic products on the Han Jiang in northern Hubei. The Dan Jiang diversion project is a major integral part of the pivotal Dan Jiang hydroelectric power project. The designed rate of flow of the channel is 100 cubic meters per second (not including the 500 meters per second rate of flow of the Henan diversion). Main and branch channels total 252 kilometers in length and provide irrigation to 2.2 million mu of cultivated land in Guanghua and Xiangyang Counties. In addition, more than 10 streams in the province's mountain and hill regions, including the Xishui, the Fu He, the Fushui, Lushui, Zhangshui, Weishui and Du He have been dammed up at narrows, their surging waters locked in gorges to form lakes and to moisten farmland in vast areas in the middle and lower reaches.

In order to solve the problem of plains lake region irrigation in drought years, floodgates have been built along rivers as a measure for diverting river water to the irrigation of fields. A total of 2,280 culvert floodgates have been built for the diversion of water. They are able to divert more than 5 billion cubic meters of water and to control a 10.67 million mu irrigation area. They have already become the principal source of water for irrigation of farmlands in plains lake regions.

In order to provide water to places where gravity irrigation is not feasible, the lifting of water for irrigation has been vigorously developed. In plains lake regions, a large number of large and medium size electromechanical pumping stations such as deep lake "five seven pumping stations" and electric pumping stations on lakes have been built for the effective irrigation of a more than 7 million mu area. Recently, in order to solve the problem of irrigation water for uplands in the northern part of the province, a main pumping station with a 175 million cubic meter lifting capacity was built at Dagangpo in Zaoyang County to control irrigation over a 300,000 mu area. In addition, more than 4,900 pump wells have been sunk throughout the province (more than two-thirds of them in Xiangyang Prefecture), and more than 3,400 of them have been equipped with pumps to irrigate a more than 250,000 mu area. In mountain areas, another more than 1,100 waterwheel pumping stations have been built to irrigate 160,000 mu of fields.

Today, more than 17 billion cubic meters of water is impounded in the province (more than 14.2 billion cubic meters of it in reservoirs, and more than

2.8 billion cubic meters of it in dammed ponds), and the total volume of water stored, diverted, or pumped totals 27.1 billion cubic meters. In addition, a more than 150,000 mu area is spray irrigated. The effectively irrigated area in the province has increased free from the pre-Liberation 8 million mu to more than 38 million mu. This is 68 percent of the total cultivated area. A fairly good foundation has been laid for fighting drought to bring in bumper harvests.

(4) Rapid Development of Mass Soil Improvement Work To Lay a Preliminary Foundation for Consistently High Agricultural Yields

Simultaneous with their major emphasis on harnessing water since liberation, the people of the province have also devoted extreme attention to the task of soil improvement. In recent years, in particular, the scope, speed and quality of cultivated land transformation, soil improvement and bringing barren mountains under control has improved. As of the end of 1978, the province's soil conservation area covered more than 33,000 square kilometers, which was more than half the area of soil erosion. Preliminary leveling of land had been completed on nearly 13 million mu throughout the province; more than 5.1 million mu of slopes had been terraced; and more than 4 million mu of drylands had been transformed into wetlands. This amounted to one-seventh of the total current wetland area. More than 17 million mu of cold waterlogged fields and sodden river lands have been brought under control. In addition, the amount of cultivated land has been increased by several million mu (see Table 2-1).

(5) Fairly Rapid Development of Hydroelectric Power Generation

Since liberation, the province's hydroelectric power generation has developed fairly rapidly. Today there are 3,070 large, medium and small hydroelectric power stations in the province, with an installed capacity totaling 1.5 million kilowatts. This includes seven large and medium size hydropower stations, each with a more than 12,000 kilowatt installed capacity for an aggregate installed capacity of 1,191,600 kilowatts, making them major energy sources for the province's industrial and agricultural production. Rural hydropower generation has developed even faster. Of the province's 3,064 small hydropower stations, 2,745 are collectively owned and have an installed capacity of more than 120,000 kilowatts. Counties with an installed hydropower generating capacity of more than 5,000 kilowatts number 29. This includes those with a more than 10,000 kilowatt installed capacity in Luotian, Yingshan, Chongyang, Tongcheng, Nanzhang, Songzi, Enshi, Jianshi and Macheng Counties. Use of electric power in agriculture has risen with the rapid development of hydroelectric power projects. As of the end of 1978, electric power used in agriculture throughout the province amounted to more than 700 million kilowatt hours. Eighty-six percent of communes, 45 percent of production brigades and 33.5 percent of production teams have electricity. In addition, use of electricity by count-operated industries has increased, reaching 955 million kilowatt hours as of 1978.

As a result of unflagging efforts during the past more than 20 years, the people of the province have completed work on water conservancy and farmland

Table 2-1 Soil Control and Improvement of Low Yield Fields in Hubei Province (as of end 1978)

Units: 10,000 mu

(a) 地、市	(b)坡地改梯地		(e)平整土地		(h)低产田改造		(k)除涝面积	
	原(c)有坡耕地	(d)坡改梯	(f)需要平整	(g)已平整	低产田面(i)积	(j)已改造	(l)易涝	(m)已除涝
Total	1,163.41	513.83	3,140.95	1,039.97	1,603.61	760.75	2,183.22	1,720.9
Huanggang	105.62	65.68	337.84	125.27	204.42	124.27	214.50	165.52
Xiaogan	73.10	42.01	309.00	63.30	147.18	71.54	209.40	154.04
Xianning	56.33	20.12	201.14	93.57	126.02	52.70	153.84	111.45
Jingzhou	82.53	33.31	1,039.52	324.47	622.24	321.49	1,287.37	1,042.85
Xiangyang	78.00	36.3	760.46	462.00	111.86	77.66	64.84	45.50
Yunyang	240.96	98.75	108.71	58.79	96.04	18.41	2.47	0.56
Yichang	169.30	96.35	164.30	84.66	101.78	52.65	73.19	66.87
Enshi	300.60	93.65	54.34	41.16	105.47	9.78	28.78	12.84
Shiyan	4.25	1.46	1.50	0.65	5.59	0.94	—	—
Huangshi	5.10	1.65	54.32	17.36	7.20	3.96	14.75	11.93
Wuhan	47.62	24.55	109.82	38.74	75.81	27.35	134.08	109.39

1. Low yield fields includes cold waterlogged fields, muddy fields, and several clayey, gravely or alkaline fields.
2. The area on which waterlogging has been eliminated includes ability to drain water from low standard fields that waterlogged once each year, and high standard fields that waterlogged once each 10 years.

Key:
a. Prefecture or city
b. Slopes made into terraces
c. Former cultivated slopes
d. Slopes terraced
e. Land leveled
f. Needing leveling
g. Already leveled
h. Low yield fields transformed
i. Low yield field area
j. Already transformed
k. Area on which waterlogging eliminated
l. Prone to waterlogging
m. Waterlogging eliminated

Table 2-2 Rural Hydropower in Hubei Province (as of end of 1978)

(a) 地、市	(b) 水电处数	(c) 设备容量 (千瓦)	(d) 农用电量 (万度)	(e) 县办工业用电 (万度)	(f) 通电		
					(g) 公社(个)	(h) 大队(个)	(i) 生产队(个)
Total	3,064	309,051	71,168	95,497	1,135	13,289	84,309
(j)占全省%		20.0	20.4	21.7	86.0	45.0	33.5
Huanggang	574	75,150	7,415	13,540	147	2,267	18,112
Xianning	392	43,944	9,252	9,608	163	1,799	14,557
Xiaogan	156	10,484	11,039	13,558	144	2,105	13,336
Xiangyang	210	24,756	9,756	23,050	126	1,836	11,809
Jingzhou	262	39,171	16,225	12,238	139	1,383	6,033
Yichang	491	44,473	8,073	10,782	125	1,155	5,578
Yunyang	479	22,496	3,129	4,756	127	1,354	4,624
Enshi	465	46,840	2,723	4,765	137	964	5,695
Huangshi	15	805	3,178	3,200	19	305	3,847
Shiyan	20	932	378	—	8	121	718

1. Use of electricity in agriculture is largely for drainage and irrigation, for commune and brigade industries, for the processing of farm products, and for illumination.
2. Percent of province as a whole means hydropower station installed equipment and total amount of electricity generated.

Key:
a. Prefecture or city
b. Number of hydropower sites
c. Capacity of equipment (kilowatts)
d. Amount of electricity used in agriculture (10,000 kWh)
e. Use of county-run industries (10,000 kWh)
f. Electric service
g. Communes
h. Production brigades
i. Production teams
j. Percent of province as a whole

capital construction projects in which the state has invested more than 4 billion yuan (not including projects for which the masses and commune and brigade collectives contributed investment). They moved more than 11 billion cubic meters of earth and rock, and built 1 meter square earthen dikes sufficient to girdle the earth 275 times. The amount of farmland guaranteed to produce a harvest despite drought or waterlogging was increased from somewhat more than 4.6 million mu of pre-Liberation times to more than 31.17 million mu as of 1978. This is roughly 54 percent of the total cultivated land area in the province, and lays a definite foundation for realization of consistently high yields in agriculture throughout the province.

2. A Certain Level of Agricultural Mechanization

(1) Marked Increase in Amount of Farm Machinery

Farm mechanization in Hubei Province was spurred by the cooperativization of agriculture. As early as 1954, the state began the planned operation of state-owned tractor stations in various parts of the province. In 1957, Liuji Commune in Xinzhou County relied on its own resources to mechanize farming in a major way. This effort generated experiences and served as a model. Thereafter, an upsurge in the mechanization of agriculture gradually occurred throughout the province. Comrade Mao Zedong noted that "The fundamental way out for agriculture lies in mechanization," and in 1966 he personally approved the convening in Hubei Province of a national on-site conference on farm machinery, which gave extremely great encouragement and impetus to the development of agricultural mechanization in the province. The amount of farm machinery in the province grew quickly. By the end of 1978, the province had farm machinery with a total of more than 7.7 million horsepower, or 5.5 times the 1965 figure, an average of 265 horsepower per production brigade. It has more than 100,000 large, medium and hand tractors, 28.6 times the 1965 figure; and more than 2 million horsepower of permanent drainage and irrigation equipment, 2.3 times the 1965 figure. In addition, substantial increases occurred in the number of metal and wooden hulled plowing boats, motorboats, mechanized transplanting machines, harvesting machines and drying machines.

Following the smashing of the "gang of four," with revival and development of the national economy as a whole came a gradual increase in the production capacity of Hubei Province's farm machinery industry. Today the province annually produces more than 4,000 large and medium size tractors, 15,000 hand tractors, and various models of diesel engines with a total of more than 1 million horsepower. It possesses a certain production capacity for the manufacture of major machines used in plowing, transplanting, harvesting, thresing, drainage and irrigation, plant protection and processing of agricultural sideline products. Throughout the province more than 1,241 commune and county farm machinery repair and manufacturing plants have been built containing more than 11,000 pieces of equipment. The plants have set the stage for rapid future mechanization of agriculture.

(2) Constant Increase in Kinds of Operations Performed and Gradual Rise in the Degree of Farm Mechanization

Accompanying the steady increase in farm machines and active development of scientific research, development and promotion of new machines has been a rapid growth in kinds of operations, and a steady rise in the degree of farm mechanization. In 1978, an 18.89 million mu area of the province was machine farmed. This was 33.3 percent of the province's total cultivated area, 2.3 times more than in 1965. In addition to the use of tractors in wetlands, people in the province's lake regions adapted general methods to local circumstances to create mechanized plowing boats and motorboats in the pioneering of a new path in the mechanization of farming in the wetlands of south China. During the past several years, most areas have progressed from initial

mechanization of drainage and irrigation, threshing and processing of grain, cotton and oil-bearing crops to new development of mechanized transplanting, harvesting, cotton field cultivation and plant protection. As of the end of 1978 the province's machine transplanted area reached 1.78 million mu. Mechanization of rock drilling, boring, bulldozing of earth, scraping of the land, sinking of wells, spray irrigation, digging of ditches and digging mud in the capital construction of farmland, plus processing livestock fodder, pruning fruit trees, picking tea, processing, removing husks from tea oil fruit and delinting cotton seeds as part of economic diversification, as well as machine operations in the pressing of fiber board and acoustic board as a part of timber processing have also seen new achievements. These have promoted development of farming, forestry, animal husbandry, sideline occupations and fisheries, and have further increased the labor productivity rate.

(3) Steady Appearance of Advanced Models of Farm Mechanization

Liuji Commune in Xinzhou County was the first advanced unit in the province to rely on its own resources for large scale mechanization of agriculture. Today this commune has 106 large, medium and small tractors and 262 power machines. Machines used in agriculture total more than 7,500 horsepower, or an average of 1 horsepower per 2.3 mu of cultivated land. It has invested a total of somewhat more than 2.37 million yuan, more than 90 percent of which it provided from its own resources. In addition, the commune has relied on the masses to act on their own initiative, unflaggingly going all out in a campaign of farm machinery innovation. They have copied, improved upon, and made more than 1,100 farm machines including bulldozers, scrapers, land leveling machines, cultivators and dump trucks. The ratio of tractors and associated equipment has risen from the former 1:1.8 to 1:6, and kinds of operations performed has increased from 12 to 28. Virtually all plowing, drainage and irrigation, processing, transportation, sowing, transplanting, plant protection, harvesting and cultivation of cotton, as well as larger scale leveling of land is now either mechanized or semimechanized, making a model of farm mechanization in the province.

In recent years Xinzhou County has scored new achievements in the mechanization of its wetlands and cotton production. In 1978, the county vigorously promoted machine transplanting of 350,000 mu, or 40.4 percent of the county's total transplant area, machine harvesting of 89,000 mu, and machine cultivation of 100,000 mu of cotton fields for marked increase in the degree of farm mechanization. In recent years, Daye County has gone on from vigorous development of "five smallnesses" in industry to take a firm grip on the "three machines" for wetlands (namely, plowing boats, transplanters and harvester-dryers), and on drainage and irrigation and processing machines. Thus, mechanization of plowing, transplanting and harvesting on wetlands throughout the county has increased substantially, providing experiences for the acceleration of the province's agricultural mechanization.

Elsewhere throughout the province, numerous advanced models have appeared, as individual circumstances have permitted, in large scale mechanized farming of wetlands and cotton fields and capital construction of farmlands, plus mechanized processing of agricultural sideline products.

3. Heartening Progress in Chemical Fertilizer Production

Hubei Province established its first chemical fertilizer plant in 1958 to use the province's own resources for development of a chemical fertilizer industry. As of the end of 1978, 62 small chemical fertilizer plants were in production in the province, plus 2 medium size nitrogenous fertilizer plants with a designed production capacity of about 1.2 million tons per year. The Zhijiang Chemical Fertilizer Plant, which was built using advanced imported technology, has a designed ammonia production capacity of 300,000 tons per year, which converts to 1.2 million tons of standard fertilizer. Trial operations were conducted during the first half of 1979, and it is expected to go into operation shortly. Hubei Province has plentiful phosphate rock resources, and in recent years its production of phosphate fertilizer has developed very rapidly. As of the end of 1978, 55 phosphate fertilizer plants had been built in the province with a production capacity totaling 760,000 tons. In addition, large quantities of phosphate rock were also mined yearly to assist fraternal provinces and cities.

Though the province has a sizeable chemical fertilizer industry that plays a definite role in promoting agricultural production, nevertheless a lack of coal and a shortage of electricity has meant that numerous chemical fertilizer plants have been unable to use their production capacity to the fullest. Insufficient chemical fertilizer is still a conspicuous problem in the province's agricultural production. In 1978, the province used about 50 jin of nitrogenous fertilizer per mu of cultivated land (including the state-supplied quota). This was lower than the national average. It was less than half the amount used in Guangdong and Zhejiang Provinces, and just slightly more than half the amount used in Hunan and Jiangsu Provinces. Further acceleration of agricultural production will require solution to the conspicuous shortage of chemical fertilizer. While devoting attention to the collection of barnyard manure and to the planting of crops and the raising of livestock to produce manure, every effort must be made to assure normal production of chemical fertilizer plants. Investment in the chemical fertilizer industry must also be appropriately increased to increase chemical fertilizer production capacity, and to improve the supply of chemical fertilizer.

Second Section. Very Great Development of Agricultural Production

1. Fairly Rapid Increase in Grain Production

Hubei Province is a major national grain producing region that has consistently provided the state a certain amount of commodity grain for many years. Statistics show that in the more than 20 years since liberation, the area of the province sown to grain crops as a proportion of the total area sown has declined from 80 percent in the period immediately following liberation to 70 percent during the past several years. Despite this, both grain output and yields per unit of area have steadily increased. In 1949, the province produced a total of only 11.563 billion jin of grain. Yields were only 178 jin per mu, only 448 jin per capita. In 1965, grain output totaled 24.038 billion jin. Grain yields climbed to 292 jin per mu, or 666 jin per capita. In 1978, grain output totaled 34.511 billion jin. Yield per mu climbed to 415 jin per mu, or 754 jin of grain per capita.

(1) Fairly Tremendous Growth in Paddy Rice Production

Paddy rice holds a dominant position among the province's grain crops, followed by wheat, corn and tubers (see Table 2-3).

The area sown to paddy rice accounts for more than 50 percent of the total area sown to grain in the province, and rice output accounts for about three-fourths of total grain output. Since liberation the broad masses of commune members have energetically transformed natural conditions, have gone all out in the practice of scientific farming, have reformed the farming system, and have promoted rapid development of rice production. For the province as a whole, two major reforms were made.

The first reform was a change from a single crop to a double crop. During the period immediately following liberation, Hubei Province was substantially a two crop area in which one crop of rice and one crop of wheat were grown. Mostly a single crop of intermediate rice was grown. In 1949, the area sown to intermediate rice was 22,319,500 mu, which was 84 percent of the wetland area. Two crops of rice were grown on only about 500,000 mu, or only 1.87 percent of the total wetland area. With improvement in water conservancy conditions and increase in the level of farm mechanization, plus the spread of new growing techniques such as hydroponic growing of seedlings in hothouses, very great restructuring of the province's wetland farming system occurred. The area growing two crops of rice expanded rapidly, and by 1978 two crops of rice were being grown on 15,729,200 mu throughout the province. This was 56.6 percent of the wetland area (see Table 2-4).

The spread of two crops of rice made further use of both the province's plentiful light and heat resources and the potential of its soil to produce increased yields. It increased rice production. By 1970, the province's area sown to two crops of rice was 80 percent larger than in 1965. This, in combination with other measures to increase yields, brought a 2.79 billion jin

Table 2-3 Table Showing Grain Crop Structure and Changes

Area: 10,000 mu; Output: 100 million jin

Kind of crop \ Year	1949			1957			1966			1978		
	(a) 播种面积	(b) 总产量	(c) 占全省粮食总产%	(a) 播种面积	(b) 总产量	(c) 占全省粮食总产%	(a) 播种面积	(b) 总产量	(c) 占全省粮食总产%	(a) 播种面积	(b) 总产量	(c) 占全省粮食总产%
Total grain	6,505.55	115.63	100.00	8,259.65	197.22	100.00	8,204.03	240.39	100.00	8,317.17	345.12	100.00
1. Paddy rice	2,463.72	75.64	65.43	3,164.48	128.53	65.17	3,613.88	173.31	72.10	4, 41.95	241.57	70.00
2. Wheat	1,165.89	10.27	8.82	1,675.56	22.16	11.24	1,489.79	22.18	9.23	1,683.42	45.56	13.20
3. Other grains	2,239.82	21.35	18.40	2,523.36	30.26	15.34	2,225.66	29.53	12.28	1,319.53	33.93	9.83
Including Corn	631.70	7.21	6.22	693.58	11.09	5.62	726.45	12.78	5.32	604.71	20.56	5.96
Including Barley	567.51	4.88	4.22	775.49	8.27	4.19	481.42	6.00	2.50	283.34	5.55	1.61
4. Tubers	293.99	5.37	4.64	386.37	9.52	4.83	496.02	9.93	4.13	643.51	18.03	5.22
Including Sweet potatoes	232.00	4.40	3.80	286.72	7.61	2.34	359.48	7.72	3.21	325.55	10.63	3.08
Including Potatoes	56.99	0.85	0.73	85.89	1.39	0.70	126.05	2.14	0.89	302.94	7.02	2.03
5. Soybeans	342.13	3.00	2.61	509.94	6.75	3.42	378.68	5.44	2.26	328.76	6.03	1.75

Key: a. Area sown
b. Gross output
c. Percent of province's total grain output

Table 2-4 Development of Two Crops of Paddy Rice

Year	Wetland area (10,000 mu)	Double rice crop area (10,000 mu)	Double rice crop area in proportion to wetlands (percent)
1949	2,655.98	49.88	1.87
1957	2,917.58	306.28	10.49
1965	2,947.74	661.30	22.43
1970	2,973.30	1,100.47	37.01
1975	2,994.15	1,809.60	60.43
1978	2,778.03	1,572.92	56.60

increase in paddy rice output. By 1978, the province's two rice crop area increased by another 43 percent over 1970, and paddy output registered another 5.87 billion jin increase. Clearly, the large-scale development of two crops of rice played a major role in the province's increased grain output. Nevertheless, in a small number of places, and in a minority of communes and brigades, poor climatic conditions, and as yet inadequate water conservancy, soil, labor and fertilizer, plus failure of farming techniques to keep pace, meant that the output of two crops of paddy was less than the output of one crop of paddy and one crop of wheat had formerly been, or even less than the output of a single crop of intermediate rice. This demonstrates that promotion of two crops of rice must be done on the basis of increased yields, with adherence to the adaptation of general methods to specific situations with no practice of "arbitrary uniformity."

In Hubei Province today, there is a great difference between early rice and late rice yields per mu. In 1978, for example, early rice averaged yields of 624 jin per mu, while late rice yields averaged only 364 jin per mu. In some counties and communes, late rice yields per mu were even lower. Not very high late rice crop output is a weak link in the province's paddy rice production, and it also is a source of great potential for increases in the province's grain production. For this reason, vigorous action to increase late crop yields per mu is a major link in development of two rice crops in the province, and in further increase in grain production.

Second is the replacement of rice varieties. Changing of rice varieties is a major element in increasing paddy yields. After 1956, the province changed from the growing of late xian varieties to late geng varieties for its two rice crops, with the result that paddy yields per mu rose rather sharply. In addition, since geng rice is resistant to cold and better able to withstand low autumn temperatures, output was also relatively consistent. During the early 1960's, when the province grew high stemmed liantanzao and xianli geng varieties, yields were only 500-600 jin per mu because of the fairly high stems, lack of fertilizer tolerance, and proneness to lodging. Subsequent to 1964, with the promotion of short stemmed rice varieties, Aijiaonante, Zhenzhuai and Guangluai No 4, output rose markedly. Yields were 600-700 jin per mu per crop under like production conditions. Where fertility

was very good, yields were 800-900 jin per mu per crop, and in some places yields even reached 1,000 jin. Spread over wide areas short stemmed varieties played a substantial role in the province's increased grain production. Beginning in 1975, the province test-planted hybrid rices such as Xianyou No 2. After success with this variety for 2 consecutive years, in 1978 it spread to a 4.8 million mu area. Hybrid rice has a well-developed root system, strong tillering, large panicles with numerous grains, rather good rice quality, and broad adaptability. Under similar conditions of fertility, proper growing techniques will produce between 10 and 20 percent higher yields than ordinary rice. In mountain regions, yields from intermediate hybrid rice are even more remarkable. Future adaptation of general methods to specific situations in the spread of hybrid rice is an important way in which the province can increase its paddy production.

(2) Steady Increase in Early Grain Production

In addition to rice, wheat is also a major crop grown in Hubei Province. In 1978, the area sown to wheat was 20 percent of the total area of the province sown to grain crops, and output accounted for 13.02 percent of the province's total grain output.

After liberation, the province's wheat production increased fairly rapidly. Yields per mu in 1978 were double those of 1949, and gross output had increased 3.4 fold. Today average yields per mu are still very low throughout the province (271 jin in 1978), and potential for future increases in yields per mu and total output is very great. In Hubei Province, wheat is usually grown as the crop just before cotton and some intermediate rice or fall dryland grain. Some is also grown as part of a new three crop system (such as wheat-rice-rice, or wheat-beans-rice). With future development of the three crop system, it is expected that the area sown to wheat may be appropriately enlarged.

Grain crops other than wheat and rice also hold a fairly important position in the province's grain production. In the province's western mountain regions, in particular, they are of greater importance. In 1978, an area of 13,195,200 mu was sown to grain crops other than wheat and rice. This was 15 percent of the province's total area sown to grain crops. Output totaled 3.373 billion jin, or 9.8 percent of the province's gross grain output. Nowadays corn is the principal miscellaneous grain crop grown in the province, output amounting to 2.256 billion jin. Despite a decline in the area sown to corn since 1965, thanks to the attention given superior varieties and restructuring of the farming system, yields per mu have increased. During the past 2 years, the popularization and spread of hybrid corn (which currently accounts for more than 70 percent of the area sown to corn) has increased yields per mu by about 20 percent and total output has increased substantially. However, in Hubei Province, average corn yields per mu are still less than the national average. Hybrid corn must be further promoted to develop corn production and efforts made to change the low yields and shortage of grain in mountain areas. Hubei Province also grows a considerable amount of barley and broad beans. Barley is grown mostly in Jingzhou, Huanggang and Xiaogan Prefectures, and in Zhijiang and Dangyang Counties in Yichang

Prefecture. Both area sown and output of broad beans are less than for barley. For broad beans are concentrated mostly in Jingzhou Prefecture and secondly in Xiangyang Prefecture, followed by Xiaogan, Xianning, Yichang and Enshi Prefectures.

Tubers (sweet potatoes and potatoes) are also counted as important grain crops grown in Hubei Province. The growing of sweet potatoes is largely concentrated in Yunyang and Xianning Prefectures, followed by Enshi, Yichang, Xiangyang and Huanggang Prefectures. The area sown to potatoes is fairly large, accounting for 54 percent of the tuber crop area. Output is about 70 percent of the total for tuber crops. Potatoes produce fairly high yields per mu. Ninety percent of all potatoes are grown in Enshi Prefecture, and account for about one-fourth of that prefecture's total output of grain. They are a staple of the diet of people in that prefecture. Following liberation, potato production developed rapidly, a 4.3-fold increase in area sown and a more than 6-fold increase in output taking place since the period immediately following liberation.

In 1978, soybeans were grown on 3,287,600 mu of land in the province, and output stood at 603 million jin. Most of them were grown on the Jianghan Plain in Jianli, Honghu, Mianyang, Qianjiang, Wuchang and Xiaoen Counties. The Jie soybeans grown at Wulijie in Wuchang are famed at home and abroad.

2. Corresponding Development of Cash Crops Such as Cotton

Hubei is one of the provinces in the country in which the proportion of cash crops grown is fairly high. In 1978, a 14,573,000 mu area was sown to cash crops. This was 12.2 percent of the province's total crop growing area, and a 33.5 percent increase over 1949. In Hubei Province, cotton holds first place as a cash crop followed by oil-bearing crops, various kinds of hemp, tobacco and medicinal herbs.

Table 2-5 Makeup of Cash Crops in Hubei Province (1978)

	Area sown (10,000 mu)	Percentage of area sewn to cash crops
Total cash crops	1,457.30	100
Cotton	889.79	61.0
Oil-bearing crops	454.32	31.1
Including: sesame	151.07	10.6
Peanuts	51.21	3.5
Various kinds of hemp	30.19	2.1
Tobacco	51.21	3.5
Medicinal herbs	22.76	1.8
Sugar crops	3.67	0.3
Other	5.36	0.4

(1) Hubei Province Is One of the Country's Important Cotton Producing Areas

Hubei Province has historically been an important cotton producing area. However, up until the time of liberation, the cotton field area was not stable and production levels were very low. In 1949, the cotton field area was 6.2 million mu, and output totaled 1.15 million dan. Yields were 18.5 jin per mu. Since liberation, cotton production has developed very rapidly. In 1978, the cotton field area stood at 8,897,900 mu and cotton output totaled 7,334,600 dan, 6.4 times the 1949 output (the all-time high year for output was 1974 when 9.59 million dan were produced). Cotton yields per mu have also increased steadily. In 1964, Eguang cotton was introduced. It became popular in 1966, the province's yields averaging 99 jin per mu. Despite particularly severe drought in 1978, the province still produced yields averaging 82 jin per mu, 4.3 times higher than yields during the period immediately following liberation. The area of Hubei Province sown to cotton is one-ninth the country's total cotton growing area, and the province's cotton output in normal years is one-fifth the country's total output. In 1976 and 1977, the province held first place in the country in both total output and yields per unit of area. Quality had also greatly improved. Both the ginning outturn rate and the whiteness rate for the province's cotton has climbed steadily while moisture content and impurity rate have declined markedly. Hubei is both a high production area for cotton and one of the country's finest cotton producing areas.

Since liberation the province has established three major cotton growing areas as follows: (1) The Jianghan cotton growing area with 5.8 million mu of cotton fields and accounting for 65 percent of the province's total cotton growing area. In this area the terrain is flat, the soil fertile, the cultivated layer thick and irrigation convenient. But the area is lowlying and prone to waterlogging. As production conditions have improved, the cotton field area has rapidly increased and most of the province's increase in cotton field area has occurred in this area. Here the cotton fields are laid out in continuous tracts, and cotton harvests are large. The first county in the province to have an annual cotton output of more than 1 million dan, Tianmen County, is in this area. (2) The east Hubei cotton growing area. In this area, cotton fields are found mostly to the east of Wuhan along both banks of the Chang Jiang on the alluvial plain and hilly uplands. The area covers about 1.8 million mu, which is 20 percent of the province's total cotton field area. Following liberation, the cotton fields in this area also increased by about 700,000 mu. In this area, population is large relative to available land; farming is done intensively, and irrigation conditions are fairly good. It is a cotton growing area of the province in which yields per mu are fairly high as, for example, in Xinzhou and Huanggang Counties, where cotton yields average more than 140 jin per mu. (3) The north Hubei cotton growing area. This includes Xiangyang, Zaoyang, Suixian, and Guanghua Counties where cotton fields cover a 1.1 million mu area or 12 percent of the province's cotton field area. In this area, two-thirds of the cotton fields are on uplands where the soil is heavy clay and leathery, and where irrigation is poor. Furthermore, population is scant relative to cultivated land; fertilizer is lacking; farming methods are extensive, and cotton yields per mu are very low.

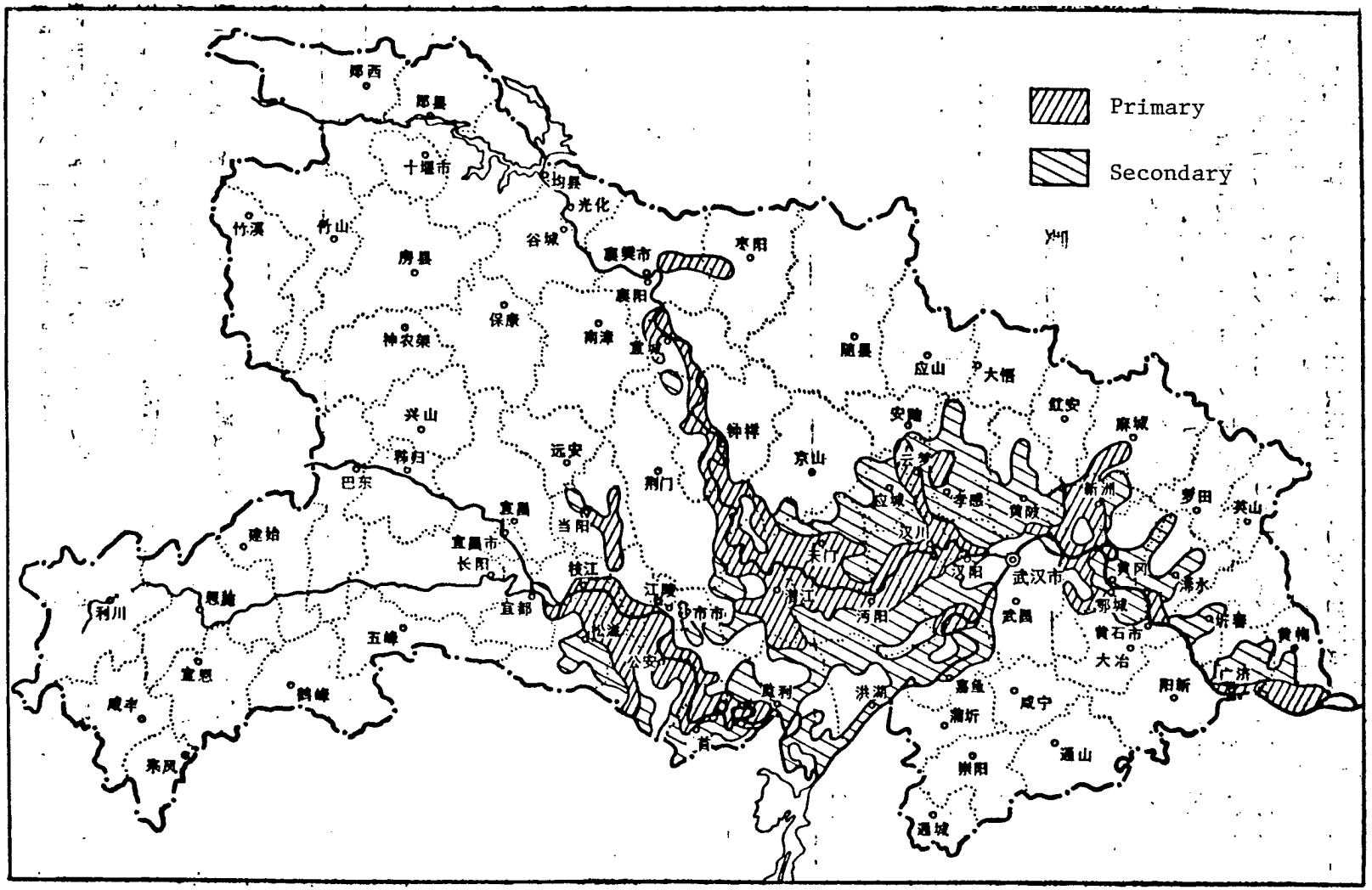

Figure 12. Map Showing Distribution of Principal Cotton Field Areas in Hubei Province

All the province's cotton growing areas have gradually promoted the companion cropping of cotton and grain in a two crop per year system. A farming system for the companion cropping of cotton and grain has been worked out that uses the features of each, the first crop planted helping the second one, and soil use being linked to nourishing the soil. In the Jianghan cotton growing area, for example, mostly barley and wheat are companion cropped with cotton, or sometimes broad beans are the companion crop. In the east Hubei cotton growing area, mostly wheat is companion cropped with cotton, but sometimes broad beans, barley, or rapeseed are companion crops. Since the companion crops used in each area are compatible with cotton and help each other grow, not only do cotton yields increase but bumper crops of grain are also harvested year after year. Twenty-seven of the province's more than 30 major cotton producing counties with more than 100,000 mu of cotton fields are self-sufficient in grain with a surplus. Despite the foregoing, cotton output today is not consistent enough. During the past 10 years, the province's cotton field acreage has been reportedly been stabilized at about 9 million mu, yet cotton output fluctuates considerably (see Figure 13). In the 6 years after 1967, for example, cotton output continued to decline by more than 3 million dan, which was a decline by one-third. Later it rose gradually. Looked at in terms of natural conditions, the main reasons have been rainy and overcast weather in the province every year, and the frequent occurrence of summer drought, both of which have considerably impaired cotton production. Current standards for capital construction of the province's cotton fields are not as high as they should be. Drainage and irrigation systems have not been linked together to form an integrated whole; cotton fields are not level enough; and in some places drainage and irrigation systems have not been separated. As a result, cotton production faces threats from both drought and waterlogging. Thus, the building of cotton fields according to high standards for consistently high cotton yields is a basic requirement for continued increases in cotton yields.

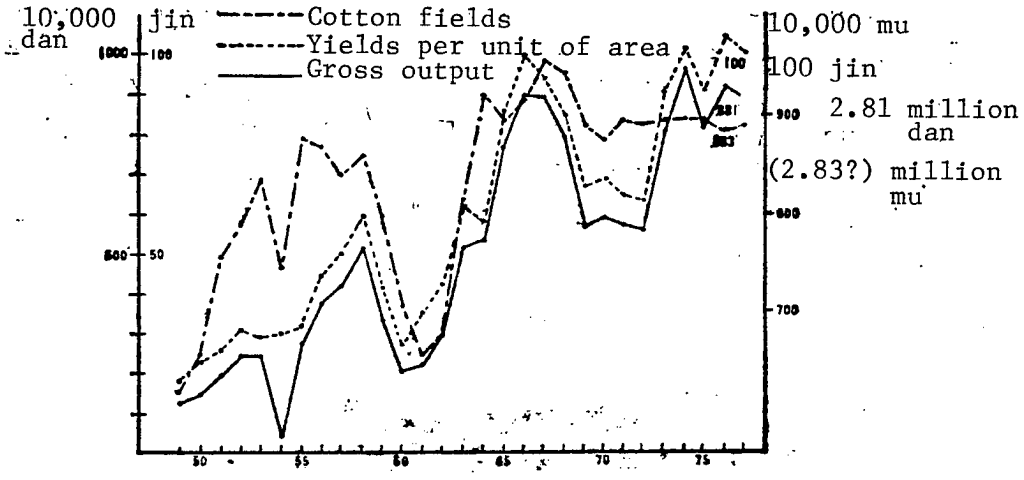

Figure 13. Graph Showing Development of Cotton in Hubei Province From 1949-1977

(2) Development of Oil-Bearing Crop Production

Since liberation, the province's oil-bearing crop production has also developed, both yields per mu and gross output increasing. The three main oil-bearing crops, sesame, peanuts and rape, produced yields of only 62 jin per mu in 1949. By 1978, yields had climbed to 104.5 jin. Oil-bearing crop acreage in 1978 was just about the same as it had been in 1949, but gross output in 1949 was 2.67 million dan versus 4,742,800 dan in 1978, a 77.6 percent increase, making Hubei Province eighth in the country in output of oil-bearing crops (see Table 2-6).

Table 2-6 Structure and Changes in Hubei Province's Oil-bearing Crops

Units: 10,000 mu

Year / Particulars / Crop	1949		1957		1966		1978	
	Area sown	Percent	Area sown	Percent	Area sown	Percent	Area sown	Percent
Oil-bearing crop total	428	100	610	100	443	100	454	100
Sesame	228	53	294	48	236	53	154	34
Rape	160	38	213	35	167	38	248	55
Peanuts	40	9	102	17	40	9	51	11

Sesame seeds are the province's principal oil-bearing crop, with output being about 30 percent of the national total for first place. The maximum output year since liberation was 1953 when 2.64 million dan were produced. Since 1965, and particularly in recent years, the sesame area has decreased greatly. The 1978 acreage was about 45 percent of the all-time high year, and output was also only about one-half. Sesame is grown mostly in the uplands of northern Hubei and on the Jianghan Plain. Xiangyang County is one of the biggest sesame growing counties in the country. In recent years as a result of the restructuring of the farming system and marked increase in the winter crop area, rape has become the province's major oil-bearing crop in terms of growing area.

Hubei Province is fairly weak in oil-bearing crop production. The oil-bearing crop acreage has steadily declined during the past several years and in 1978 the area planted to oil-bearing crops was 2 million mu less than during the all-time high year of 1953. This included a more than 1.8 million mu reduction in the sesame area, and a more than 500,000 mu reduction in the peanut growing area. The area planted to rape increased. Gross output of oil-bearing crops has likewise failed to reach the all-time high (see Table 2-7). Future acceleration of oil-bearing crop production will require emphasis on the growing of rape. Planned expansion of the rape growing area will be necessary and the sesame and peanut growing areas will have to be stabilized. Efforts will have to be made to increase yields per mu in order to increase output and reach or surpass the all-time high level.

Table 2-7 Development of Oil-Bearing Crop Production in Hubei Province

Units: 10,000 mu, 10,000 dan

Particulars / Amount / Year	Total oil-bearing crops		Peanuts		Sesame		Rape	
	Sown area	Gross output	Sown area	Gross output	Sown area	Gross output	Sown area	Gross output
1949	428.08	267.49	40.12	63.31	227.73	121.84	160.22	82.33
1957	609.52	505.17	102.19	224.56	294.00	183.29	212.67	97.14
1966	442.96	314.39	40.15	57.22	235.51	172.79	166.52	84.20
1978	454.32	474.28	51.21	98.06	154.07	160.35	247.90	214.40
All-time high years								
1953		525.99				263.69		
1956				238.84				
1975								213.03

(3) Important Position of Hemp, Silk, Tea and Tobacco

Hubei Province is an important area for the production of ramie, and ranks first in the country. Ramie fiber is fine and soft, and color and luster are quite good. It is prized in both domestic and foreign markets. Ramie is grown mostly in Yangxin, Daye, Puche, Xianning, Jiayu, Wuchang, Jinchun, Enshi, Guangji and Echeng Counties. Output in the maximum output year since liberation (1957) was 343,000 dan. Subsequently, as a result of competition between grain and hemp crops for land, the growing area steadily declined. Yields per unit of area also declined, and gross output gradually declined as well. In 1978, gross output was only 115,100 dan, 33.56 percent of the all-time high year, and Hubei Province slipped to second place nationally in the production of ramie. As a result of the decline in output, most of the ramie produced today can be used only for military production or in the fishing industry. Little finds its way directly into use in the people's daily lives, and the amount exported has also declined. It will be necessary to stabilize and increase the ramie growing area and strive to increase yields per mu as well as gross output to supply both the people's needs domestically and international markets.

Formerly the province's needs for jute and ambari hemp were met either by transporting them from other provinces or through foreign imports. After 1965, however, the growing of both advanced fairly rapidly in the province, and they are now grown mostly in Shishou, Mianyang, Jianli, Qianjiang, Xiangyang, Zaoyang and Guanghua Counties. In 1978 the jute and ambari hemp acreage was 125,800 mu and output was 204,900 dan (ripe jute and ambari hemp). However, this is able to satisfy only one-third of present needs. Potential for development of jute and ambari hemp is very great and further efforts must be made to achieve total self-sufficiency in them.

Mulberry silkworms have a long history of development in Hubei Province. Silk cloth from Tianmen and Mianyang Counties have been sold as far away as Southeast Asia. During the period immediately following liberation, most silk was produced in Tianmen, Mianyang and Qianjiang Counties, but now silk is produced in more than 10 counties including Luotian, Macheng, Xishui, Huanggang, Huangmei, Yuanan, Jianli, Tongcheng, Xiangyang, Nanzhang and Guanghua. Initial steps have been taken to make Luotian County into a foreign trade base county for the production of nearly 30,000 dan of silkworm cocoons annually. Formerly mulberry trees were grown here and there in the "four besides" [beside roads, streams, villages and houses], but now they are grown in mulberry groves in mountains and on river flats. In 1978, mulberry was grown on a 400,000 mu area and the province's output of silkworm cocoons rose from the 15,000 dan of the period immediately following liberation to 94,200 dan, a more than five-fold increase.

The province formerly produced very few tussah silkworms, but recent years have seen their production in Suixian, Gucheng, Baokang, Junxian, Yunxian, Xunxi, Luotian and Macheng Counties, which annually produce more than 20,000 dan of cocoons.

Hubei Province's potential for silkworm cocoon production is very great. Were each mu of existing mulberry groves to produce cocoons at the national level (60 jin), gross output would be 240,000 dan. In addition to the use of barren slopes and river flats for expansion of the mulberry grove area, future emphasis should be placed on improving the management of existing mulberry groves, on solving the fertilizer shortage, on use of more intensive methods, on increasing mulberry leaf output, on raising silkworms scientifically, and in catching up with and surpassing advanced national levels.

Tea growing has developed rapidly in the province. In the period immediately following liberation, tea was grown only in 10 counties in western and southern Hubei and output amounted to only 30,000-odd dan annually. Today most counties grow tea and counties having an annual output of more than 10,000 dan number 11 and include Puche, Xianning, Tongshan, Tongcheng, Chongyang, Enshi, Efeng, Yichang, Wufeng, Yingshan and Xishui. Puche County's annual production is more than 50,000 dan. In 1978, the province produced 346,900 dan of tea, nine times more than in 1949. The province's "Yichang red tea" is widely sold abroad, its "dark green tea" is sold in the country's frontier areas and its "green tea" is sold throughout the country. The building of tea production bases will have to be accelerated to make the 11 aforementioned counties into base counties each of which produces 50,000 dan of tea annually. Other counties should mostly strive to raise yields per unit of area, to improve tea processing techniques, and to upgrade tea quality. Areas producing "dark green tea" should reduce their output of "dark green tea" in a planned way and develop green tea instead.

Since liberation, tobacco production has gradually increased in the province. In 1978, 512,700 mu were sown to tobacco and output totaled 1,073,000 dan or 5.3 times the 1949 output. Formerly, the province produced mostly sun-dried tobacco, and Huanggang's sun-dried tobacco enjoyed a reputation in international markets. Since 1962, however, with energetic efforts to produce

flue-cured tobacco, the position of sun-dried tobacco has gradually given way to flue-cured tobacco. In 1978 the flue-cured tobacco growing area was 370,100 mu and output was 759,500 dan, or 70.78 percent of the province's total tobacco output. Today the former situation of relying on imports of tobacco from other provinces has been substantially changed. Flue-cured tobacco is found mostly in Xishui, Hongan, Huanggang and Dawu Counties in eastern Hubei, in Xiangyang, Zaoyang and Guanghua Counties in northern Hubei, and in Lichuan County in Enshi Prefecture. In order to meet the needs of foreign trade markets, in recent years much effort has gone into developing white rib tobacco. In 1978, 98,300 mu of white rib tobacco was grown, and output was 260,700 dan, or about 70 percent of the country's total output. White rib tobacco is grown mostly in the counties of Enshi Prefecture in western Hubei.

Third Section. Steady Development of Forestry, Animal Husbandry and Fishing Industry

1. Forestry

Up until the time of liberation, the province's forest area was small and the cover rate low. In 1949, the province had a forest area of only some 37 million mu. In many places there were barren mountains; soil erosion was extremely severe; and both timber and firewood were very scarce. After liberation, the people of the province actively responded to the call of Chairman Mao to "make the motherland green." They began the afforestation of barren mountains and the planting of trees in the "four besides," accomplishing very much.

(1) Great Achievements in the Afforestation of Barren Mountains and the Planting of Trees in the "Four Besides"

During the 1950's, between 400,000 and 500,000 mu were afforested annually, and during the 1960's between 1 and 2 million mu were afforested annually. During the past several years, between 3 and 4 million mu have been afforested annually. As of 1978, the province had more than 20 million mu of forest reserves in continuous tracts and more than 400 million trees growing in the four besides. Trees had been planted along 1,576 kilometers of main highways and along more than 940 kilometers of railroads. Both banks of the Chang Jiang and the Hanshui have been substantially planted to trees, with more than 1,700 kilometers of trees planted to break waves and protect dikes. Throughout the province, 50,000 mu of large, medium and small reservoir areas have been planted to trees and about 9,000 kilometers of main and branch irrigation canals have been planted to trees.

In the vast, sparsely populated, and barren mountain tracts of western Hubei, airplanes were used to sow seeds in the afforestation of more than 2.39 million mu. Places earlier sown by air have now become forests. Luotian County in the southern foothills of the Dabie Shan was formerly a place of "barren mountains, dried up waters and infertile fields." Now, after many years of effort, it is gradually becoming a land of "green mountains, beautiful waters and fertile fields." They tackled problems concerning mountains, rivers, farmland, forests and roads in a comprehensive way, working on farming and forestry simultaneously for all-around development. The protected afforested area is 1.65 million mu. Virtually all the county's barren mountains have been made green. Annual output of timber is more than 15,000 cubic meters (not counting timber used by communes and brigades themselves and for the production of tackahoe), and annual output of moso bamboo is 300,000 plants; more than 5 million jin of charcoal, 5.25 million jin of Chinese chestnuts, 870,000 jin of tuckahoe and 170,000 jin of tea. Income from forestry accounts for about 30 percent of the county's gross earnings from agriculture. Qianjiang and Gongan counties located in the water-laced lake area of the Jianghan Plain used to have "flooding as far as the eye could see and a scene of desolation once the waters had receded." Now it has become "a forest

belt with row upon row of trees, fields laid out in rectangles, rivers and lakes glinting green, and trees shading roads." Simultaneous with its development of agricultural production, Qianjiang County launched a mass campaign of afforestation of "a handful of seeds for each household and 1 mu of seedlings for each production team, which succeeded very well. Today, trees have been planted virtually everywhere throughout the county on both sides of highways and irrigation ditches, in front of and behind villages and surrounding houses. In addition, sandy river flats and wastelands have become afforested tracts. Since 1968 the county has felled more than 300,000 cubic meters of small diameter timber, and has become virtually self-sufficient in supplying timber for its people. Since 1972, the county's grain production has greatly increased, cotton production has reached the target set by "The National Program for Agricultural Development," and live hog production has also developed rather rapidly. The county has the prosperous look of a place in which forests are lush and grain plentiful with all six kinds of livestock flourishing.

Today the province's forest cover rate has increased to 21 percent from the 13 percent of the period immediately following liberation and forest reserves have increased to more than 80 million cubic meters.

(2) Rapid Development of Forestry Bases

Since the beginning of the 1970's, building of the province's forestry industry has developed to a new stage of planned, key area, large-scale building of forestry bases. The building of "two kinds of forest" bases (those for timber and those for oil-bearing trees) has developed rapidly with the growing of mostly Chinese fir, tea oil and olive trees. As of the end of 1978, the province had 19 Chinese fir tree base counties in which fir forests covered an area of 4,123,000 mu; 21 tea oil base counties covering 1,365,000 mu, and 23 olive tree base counties slated for the planting of more than 100,000 mu of olive trees. Counties with a Chinese fir tree area of more than 100,000 mu included Chongyang, Xianning, Guangji, Jinchun and Changyang. Counties in which the tea oil area was more than 50,000 mu included Macheng, Yingshan, Hongan, Yangxin and Jianshi. Counties slated for the growing of more than 10,000 olive trees included Wuchang, Hanyang and Yingcheng. Xianning Prefecture has been noteworthy for its achievements in the building of forestry bases during the past several years. The prefecture has already built 23 tracts with more than 10,000 mu of Chinese fir and 4 tracts with more than 8,000 mu of tea oil trees. The Chinese fir tree bases cover a 1,226,000 mu area and the tea oil bases cover a 250,000 mu area. In 1978 the province planned to build an additional 18 tung oil base counties. It currently has 1,141,700 mu of tung oil forests.

(3) Remarkable Achievements in Building Forest Farms

Since the founding of the People's Republic, a series of state-owned forest farms have been established in the vast, sparsely populated, barren mountainlands of the province. These forest farms have played a role as models and as mainstays in the building of forestry. As of 1978, Hubei Province had established 153 state-owned forest farms covering an area of 4,663,000 mu.

A more than 2.63 million mu preserve was afforested, which increased the forested area to 3,414,000 mu including nearly 3 million mu of timber forests, timber reserves reaching the 5.83 million cubic meter mark, and moso bamboo plants numbering 7.4 million. At the same time 1,060 kilometers of forest zone highways were built, plus 1,695 forest roads and 4,321 kilometers of fire lanes. Sixty watch towers were erected. Numerous forest farms have, or will shortly, become timber production bases.

Commune and brigade operated forest farms are a very good way in which to accelerate the development of forestry, hasten the building of mountain regions and strengthen the collective economy. As of 1978, more than 21,000 communes and brigades throughout the province, or 69 percent of the total number, operated forest farms. Of the total, more than 19,400 or 65.7 percent were forest farms operated by brigades. Commune and brigade-operated forest farms covered an area of more than 21.7 million mu, and included more than 14 million mu of forestland, and more than 230,000 permanent workers who played a very important role in the greening of the province's barren mountains and the development of forestry.

Substantial development has also taken place in forestry machinery. As of 1978, the province's forest farms had 1,020 large and medium size machines of various kinds, with 7,657 horsepower, and an installed electric power generation capacity of 1,439 kilowatts. Since 1973, Xianning, Xiangyang and Jingzhou prefectures have each established forestry machine plowing stations using machinery with 1,048 horsepower. Establishment of forestry machine plowing stations have played a major role in both state-owned forest farms and in afforestation at forestry bases. During the past several years 14 counties and 36 communes have prepared a 350,000 mu land area for afforestation.

(4) Steady Rise in the Level of Forestry Science and Technology

During the 1950's and the early 1960's, the province used a single tree variety in afforestation. An overwhelming majority of forestlands were afforested with massoon pines, and the preliberation "single chop with a hoe method of planting," and lack of intensive care produced large areas of low yield forests, and even resulted in "small old trees." Since the 1970's, the whole province has promoted Guangji County's experiences in "making troughs when preparing the soil" to plant Chinese firs, and use of the "three deeps" [deep digging, deep planting and deep care] which has greatly improved the quality of afforestation. Chinese fir base afforestation is concentrated on continuous tracts where the "making of troughs in preparing the soil" is practiced with tending and intercropping being done year after year. Tea oil bases have set up large areas of "three conservation" lands that conserve water, soil and fertilizer and practice obtaining "three portions of oil from each portion of land." Tree varieties used in afforestation have also been gradually diversified and the principles of adapting general methods to specific situations, suiting trees to locales and scientific afforestation adhered to. Tree varieties used for the afforestation of high mountain areas include firs, metasequoias, cryptomeria, larches, Pinus armandii, Chinese pines, sassafras and Liriodendrom Chinese trees. In addition to the use of

massoon pines in the afforestation of hills and low mountains, active use has also been made of fine timber tree species such as Chinese fir, cypress, Pinus elliottii and Pinus Taeda. In plains lake regions, simultaneous with energetic development of local varieties such as Chinese ash and chinaberry, has been the introduction of rapid growing timber tree species such as metasequoia, Taxodium ascendens, Chinese toon trees and paulownia. Metasequoias grow particularly fast, and now they have been promoted in more than 70 counties in the province to become one of the principal species of trees grown in the "four besides" and for planting in cities and towns. Success has been achieved with the importation of olive trees from abroad during the 1960's. The olive trees decided on for planting by the Provincial Forestry Institute in 1964 produces between 40 and 70 jin per mu of oil and some individual trees produce as much as 171 jin of olives, which converts to 34 jin of oil.

In order to make forestry production advance toward the goal of superior varieties, the attainment of rapid growth, bumper output, and fine quality, work has been undertaken in the selective breeding of superior forest tree varieties. As of 1978, 302 individual superior trees had been culled from among Chinese finest metasequoias, Pinus elliottii, Taxodium ascendens and cryptomeria, as well as olive tree varieties, and more than 11,800 mu of seed plots had been set up (with grafting having been done on 1,216 mu), plus more than 780 mu of fields to provide grafting branches, and more than 17,300 mu of mother tree forests. The mother tree forests and seed plots that were first planted have already begun to fruit and will soon provide superior seeds.

In order to do an effective job of prevention and control of forest tree insect pests and protect forest resources, Hubei Province has energetically promoted advanced methods of "using insects to control insects" and of "using bacteria to control insects," which has spread to more than 30 counties. In 1978, the province produced almost 1,000 tons of batrytis bacteria, and 12.5 billion artificially bred trichogramma for the control of pine moths over a 1.24 million mu area in the effective control of pine moth damage.

(5) Gradual Development and Strengthening of the Forestry Industry

Hubei Province has actively developed the forestry industry and has made better use of forest resources to assist in the building of industry and agriculture. As of 1978, it had produced a total of 12 million cubic meters of timber, and 94 million stalks of moso bamboo. In order to develop the Yuanan and Dangyang, Lichuan and Xianfeng, and Dahong Shan forest areas, 5,243 kilometers of forest area highways were built throughout the province plus 5,700 kilometers of forest roads, and 170 ropeways totaling 132,800 meters in length for the transportation of timber. It also dredged 8,400 kilometers of streams.

Many forest areas have put into practice a program of "taking forest operation as the basis, giving equal emphasis to afforestation and the management of forests, and linking felling to growth for all-around use of forests." They have both devoted attention to the afforestation of bald mountains and the establishment of new bases and have also made sure to link felling to growth, to the replacement of cutover land, and to the revival of old forest zones.

In order to change the situation in some areas of only felling without growing or cutting more than planting, and to better link felling to growth, it has been proposed that communes and brigades establish felling and growing farms. Statistics from 1978 show that the province's major forest areas already had more than 260 commune and brigade felling and growing farms covering an area of 5.28 million mu on which 134,000 cubic meters of timber was cut annually. The cutting renewal area was 36.5 percent of the felled area; the second growth renewal area was 490,000 mu, and 128,000 mu of barren mountains were afforested. In some forest areas, afforestation has been greater than felling, the greater the felling the more trees.

In order to make use of forest resources in multiple ways, the province established six artificial board plants (or workshops), and another five such plants are abuilding. In 1978, these plants produced 6,500 tons of manmade boards, the equivalent of 37,050 cubic meters of timber. Seventy plants for the processing of small pieces of timber and small pieces of material were set up in timber producing counties. During the past several years they have effected a saving of more than 6,000 cubic meters of timber through the use of small pieces of timber and materials. A fairly large state-owned rosin plant and tannin extract plant have been built with an annual output capacity of 600 tons of rosin and 5,000 tons of tannin extract.

2. Animal Husbandry Industry

In order to meet needs in building the cause of socialism in various ways as well as to improve the peoples standard of living, the province's animal husbandry industry has developed considerably since the founding of the People's Republic (see Table 2-8). Statistics show that during the period immediately following liberation, the province's hog, cattle, sheep and goat inventories amounted to only 5.45 million head, but had grown to 22 million head by 1978, a more than four-fold increase in the number of livestock in inventory. Output value of the animal husbandry industry reached 1.008 billion yuan, or 11.7 percent of the gross output value of agriculture.

Table 2-8 Animal Husbandry Industry Output in Hubei Province in Major Years

Units: 10,000 head

Particulars	1949	1957	1966	1978	1978 compared to 1949 ±absolute figures	1978 compared to 1949 ±percent
Number of hogs in inventory	318.22	762.45	1,018.30	1,706.23	1,388.01	436.2
Fattened hogs removed from inventory	113.20	403.25	586.50	919.33	806.13	712.1
Number of large livestock animals	218.11	284.43	352.70	345.76	127.65	58.5
Including: plow oxen	202.73	266.65	338.96	333.39	130.66	64.5
Number of sheep and goats in inventory	24.00	62.70	80.94	155.07	131.01	546.1

(1) Great Development of Hog Raising

Live hogs are the barnyard livestock grown in the largest numbers and occupying the most important position in Hubei Province and they are also the principal source of meat for the people in the province's cities and villages. Up until the time of liberation, hog raising in Hubei Province was extremely backward.

The masses raised hogs by allowing them to forage for themselves; communicable diseases were prevalent, and the death rate was very high. In 1949, the province had only 3.18 million head of live hogs in inventory, or an average of only 0.55 head per peasant household. During the 30 years since liberation, the hog raising industry has developed greatly. By the end of 1978, live hogs in inventory numbered 17.06 million head, an average of 2.12 head per peasant household, or 4.4 times the 1949 number. Fattened hogs removed from inventory numbered 9,193,300, 7.12 times the 1949 number. Twenty-two counties, including Tianmen raised a substantial number of hogs (see Table 2-9). In 1978, these counties accounted for more than 44 percent of both the number of hogs in inventory and the number of fattened hogs produced in the province. The county in which households removed the largest average number of fattened hogs from inventory was Danyang County (an average of 2.26 head per household). In 1978, all jurisdictions turned over to the state 2.11 million head of fattened hogs, and exported 398,000 head. They supplied Hong Kong with more than one-seventh the total number of live hogs supplied by the country. The province's hybrid hogs earned a fine appraisal in Hong Kong and Macao markets as being "well shaped, containing much lean meat, being tasty and being attractive in color."

Table 2-9 Live Hog Production in 22 Hubei Counties in 1978

Units: 10,000 head

County	Year-end number in inventory	Number removed from inventory	County	Year-end number in inventory	Number removed from inventory
Tianmen	49.92	28.34	Qianjiang	33	15.18
Suixian	46.34	25.68	Jianli	31.62	18.59
Jingmen	43	22.10	Zhijiang	31.29	17.62
Xiangyang	42.62	18.49	Songci	30.81	21.25
Zhongxiang	60.72	20.48	Nanzhang	30.20	13.48
Macheng	36.31	17.06	Jinchun	30.19	12.40
Mianyang	36.01	21.75	Yichang	30.12	16.14
Gongan	35.81	22.04	Enshi	28.37	17.01
Zaoyang	34.78	15.37	Echeng	25.35	15.43
Dangyang	34.11	17.42	Xiaogan	23.68	15.08
Jiangling	33.11	21.36	Total	760.41	407.14
Xishui	33.06	14.87	Percent of total for the province	44.6	44.3

(2) Increase in Raising Cattle, Sheep, Goats and Rabbits

In 1978, the province had 3,457,600 head of large cattle, 96.4 percent of them plow oxen. Horses, donkeys and mules were very few in number, and used mostly in transportation. As of the end of 1978, plow oxen in inventory numbered 3,333,900 head, a 60.8 percent increase over the 1949 number. This included 1,873,000 common oxen and 1.46 million water buffalo. Additionally, there were 9,817 dairy cattle, more than 10 times the 1949 number. In 1978, fresh milk output stood at 39.08 million jin. In recent years, Hubei Province has also imported from abroad some Simmental, Hereford and Kanghangwang [2123 2487 3769] beef cattle for hybridization and improvement in the province's common oxen breed as well as for establishment of superior variety frozen semen stations. Eighteen counties have begun artificial insemination using frozen semen to energetically develop beef cattle production. Suixian, Xiangyang, Zaoyang, Yicheng, Nanzhang, Zhongxiang, Jingmen, Jingshan and Yingshan counties have been designated national beef cattle production bases. As a result of the launching of work to improve cattle breeds, both quality and commodity rate have risen.

The province's sheep and goat raising industry has developed rapidly, and far more rapidly than the cattle industry. As of the end of 1949 the province had 240,000 head of sheep and goats in inventory. By 1978, this number had grown to 1,550,700, a 6.5-fold increase. Sheep and goats raised by collectives numbered 485,000, or about one-third the total number in inventory. Goats held a commanding position in the sheep and goat raising industry. There are 1,443,900 goats in the province at the present time, which is 93 percent of the total sheep and goat population. Mostly they are concentrated in mountain counties such as Changyang, Badong, Fangxian, Wufeng, Xunxi, Jianshi, Zigui, Lichuan, Enshi and Yunxian. These 10 counties have an average of more than 50,000 head in inventory, which is one-third the total number of goats in the entire province. Changyang and Badong Counties, which have broken the 100,000 mark in the number of goats in inventory have been designated national goat production base counties. The province has a total of 106,800 sheep, most of them in Zaoyang, Xiangyang, Suixian and Yicheng Counties in Xiangyang Prefecture, which has two-thirds the total number. In 1978, the province purchased a total of 120,000 head of sheep and goats for consumption, 930,000 jin of wool and goat hair, and 704,000 sheep and goat skins. The province's "Yichanglu" and "Hankoulu" goat skins are tough, soft and pliable, have good tensile strength and are even in thickness. They enjoy a high reputation in international markets. Between 1973 and 1978, the province made more than $5 million in foreign exchange for the country from the export of the processed light industrial products, goat skin, goat hair and goat casings.

The province's rabbit raising industry has also developed well, with more than 1 million rabbits grown in the province in 1978. Most of them were raised in Zaoyang, Mianyang, Yunmeng, Anlu, Xiangyang, Nanzhang and Macheng Counties. Rabbit skin and hair is one of the province's export items, and in 1975 exports of processed frozen rabbit meat began.

(3) Substantial Contributions of Poultry, Eggs and Honey

Poultry and eggs are major livestock products in the province, and hold an important position nationally. In most years, about 50 million chickens and ducks are maintained in inventory, chickens accounting for three-fourths of the total. The state annually purchases more than 2 million chickens and ducks, and in 1978 purchases reached 5.22 million. In recent years, state purchases of fresh eggs have averaged more than 100 million annually, and in 1978 the state purchased 165 million of them, 25.7 percent more than in 1977. Eighty percent of them were chicken eggs, and quantities purchased were the highest in the country. In addition to supplying the large quantities of fresh eggs needed by the people of the province themselves, between 20 and 30 million have been exported each year. Most of the eggs that the state purchases come from all the counties on the plains and the hills. In 1978, 40 provinces had fresh egg sales to the state of more than 1 million jin each, and 16 of the 40 were hailed as national red banner counties (counties in which state purchases were more than 4 million jin or an average of more than 30 jin per household). One-fourth of the red banner counties in the country were in Hubei Province. They were Mianyang, Jianli, Jingmen, Jiangling, Tianmen, Zhongxiang, Qianjiang, Honghu, Gongan, Suixian, Anlu, Yingshan, Jingshan, Yingcheng, Yicheng and Shashi City.

Hubei Province has had a long history of apiculture, and has always held an important position in the country. In 1978, 270,000 hives of bees were raised in the province and produced more than 220,000 dan of honey, 132 percent more than in 1977. In Hubei Province, two-thirds of all bees are Italian bees. Mostly they are raised by collectives and chiefly in counties on the Jianghan Plain and along railroads. Chinese bees account for one-third the total number and are raised mostly in mountain and hill regions. Mostly commune member households raise them. In 1978, counties in the province from which the state bought more than 5,000 dan of honey included Huangpi, Hanchuan, Xiaogan, Yunmeng, Xinzhou, Suixian, Xiangyang, Hanyang, Enshi, Jingmen, Dawu and Zaoyang.

3. The Fishing Industry

Hubei Province has been well known far and wide for a long time for its fishing industry. Under the reactionary Kuomintang regime, however, fishing industry production was extremely backward. Yields were low, and catches averaged only 4½ jin per mu. Following liberation, energetic transformation of natural water surfaces, multiple use of water and soil resources and development of artificial breeding brought about definite development of the province's fishing industry production. In 1977, the province reared 190 million jin of adult fish, a 14 percent increase in average output over the period 1971-1975. Yields of reared fish reached 50 jin per mu versus 36 jin during the period 1971-1975, a 40 percent increase.

(1) Continued Growth in Output of Artificially Reared Fish

The province's rivers and lakes had formerly been only natural breeding grounds for crustaceans and fish, and the fishing industry consisted mostly

of natural catches in rivers and lakes. The period of the First 5-Year Plan saw rapid development of the artificial rearing of adult fish, and outputs increased year by year. By 1957, output of artificially reared adult fish approached 100 million jin, which was about 10 times the 1949 output. Further increases brought the 1977 figure to 19 times the 1949 one. Analysis of adult fish gross output shows an average 61 percent annual increase in gross output for the period 1971-1975 as compared with the period immediately following liberation. This included an 11-fold increase in output of artificially reared fish. Despite a 25 percent decline in natural catches during the same period, annual absolute output still remained at between 500,000 and 600,000 jin. This fully demonstrated the very great changes that had taken place in the province's fishing industry production, i.e., the approximate ratio between natural catches and amounts artificially bred had changed from the approximately 9 to 1 of the period immediately following liberation to approximately 1 to 3 during the period 1971-1975. The steady rise in outputs of artificially reared adult fish not only made up for the decline in natural fish resources, but also promoted development of fishing industry production.

(2) Steady Expansion of Freshwater Varieties Reared

The natural waters of the province contain more than 30 species of important economically valuable fish, which have historically been the major fish sought in natural catches. Since the founding of the People's Republic, the province has actively developed artificial breeding. It has both selectively bred natural freshwater fish of economic value, but has also continually imported from abroad new varieties for breeding. As of recent years, the province has had about 30 freshwater breeding varieties (see Table 2-10).

Table 2-10. Freshwater Fish Presently Bred in Hubei Province

Fish	Snail carp, grass carp, silver carp, bighead carp, common carp, crucian carp, megalobrama, triangular bream, Changchun bream [7022 2504 7653], red carp [4767 7642], jingli [6975 7642], baiji [4101 7651], snakehead [Ophiocephalus argus], Squaliobarbus curriculus, Carraisius auratus gibelio, xilinmigu [4798 7673 1378 7625/0942], Xenocypris argentea, Plagiognathops microlepis, huangweimigu [7806 1442 1378 7625/0942], river eel
Nonfish	Crabs and soft-shelled turtles

(3) All-Around Control of Natural Lakes To Advance Breeding of Consistently High Yields

As part of its construction of water conservancy projects, the province carried out all-around control of its natural lakes. It set water levels for the breeding of fish, built fish ponds, increased the number of fish screens, and went in for artificial rearing of fish, achieving considerable success in these efforts. Implementation of a program of "taking the fishing industry as a key link, economic diversification, comprehensive use and all-around

development" was particularly successful in producing unprecedented records in the breeding of lake fish (see Table 2-11).

Table 2-11 High Yield Records for Lake Fish Breeding in Hubei Province (1977)

Category of breeding lake	Name of lake	Breeding surface (mu)	Adult fish yields per mu (jin)	Location
Water surfaces larger than 10,000 mu	Dong Hu	22,000	60	Wuhan City
	Yaer Hu	16,000	51.3	Echeng County
Water surfaces smaller than 10,000 mu and above 3,000 mu	Zhulin Hu	9,000	139	Yangxin County
	Nan Hu	7,900	120	Huangshi City
	Moshui Hu	6,200	153.2	Wuhan City
	Baitan Hu	6,000	102.2	Huanggang County
	Nan Hu	4,500	121	Wuhan City
	Yujia Hu	3,000	640	Wuhan City

Rich experience was gained in winning consistently high yields from lake breeding at Baitan Hu in Huanggang County and at Zhulin Hu in Yangxin County, which were comprehensively controlled natural lakes.

(4) Use of Dammed Ponds and Reservoirs To Expand the Fishing Industry for an Increase in Food and Flourishing of Fisheries

In Hubei Province, the fishing industry based on dammed ponds has expanded rapidly. As of 1977, 79 percent of all dammed ponds capable of rearing fish were already being used for that purpose, the utilization rate for ponds ranking first among all bodies of water in the province. (Table 2-12) In addition, though dammed ponds account for only 30 percent of all water surfaces in the province devoted to the rearing of fish, they produce 59 percent of the province's total output of adult fish. Dammed ponds are very important to the province's fishing industry. Even while going all out in grain production, today numerous communes and brigades are actively developing the rearing of fish in dammed ponds to obtain high yields. In 1977, 11 communes and 91 production brigades had fish yields of more than 300 jin per mu. In many communes and brigades the fishing industry has played an active role in advancing agriculture. In the 19 years since its communalization, Shiyue Production Brigade in Xishui County has used 139 mu of dammed ponds to rear fish, earning more than 970,000 yuan from the effort, more than 567,000 yuan of which it turned over to the brigade for its accumulation fund. These funds were more than 40,000 yuan more than the brigade's total investment in machinery and electric power equipment.

Table 2-12 Water Surfaces Used for Rearing Fish in Hubei (1977)

(a)		可(b)养水面		已(c)养水面		(d)已养水面占可养水面比重(%)
		(e)面积(万亩)	(f)比重(%)	(e)面积(万亩)	(f)比重(%)	
(g)		686.6	100	384.9	100	56
(h)	港(i)渠	12.9	1.9	7.3	1.9	56
	塘(j)堰	149.1	21.7	117.9	30.7	79
	水(k)库	220.8	32.2	120.5	13.2	58
	湖(l)泊	303.8	44.2	139.2	36.2	45

Key:
a. Body of water
b. Water surface in which fish can be reared
c. Water surface used for rearing of fish
d. Water surface used for rearing of fish as a percentage of water surface in which fish can be reared (percent)
e. Area (10,000 mu)
f. Proportion (percent)
g. Total water surface
h. Including
i. Streams and irrigation canals
j. Cammed ponds
k. Reservoirs
l. Lakes

The large amount of reservoir construction in Hubei Province has created favorable conditions for development of a reservoir fishing industry. Within a year following the beginning of the rearing of fish in the Jinpenyuli Reservoir in Xiaogan in 1953, 37 large and medium size reservoirs, or 70 percent of all large and medium size reservoirs in the province at that time, had been stocked with fry. As a result of many years practical experience, the province has created quite a few high yield records for the rearing of fish in reservoirs (see Table 2-13), and has gained precious experience.

Table 2-13 High Yield Records Set in Rearing of Fish in Reservoirs in Hubei Province

Name of reservoir	Location	Fish rearing area (mu)	(a)成鱼高产记录(亩产斤)	Year record set
Mingshan	Macheng	10,000 (mountain region)	85	1972
Meichuan	Guangji	2,500 (hills)	108	1972
Baizhang Tan	Tongcheng	(b)750(海拔800米山区)	104	1974
Huilongshan Reservoir	Huanggang	600 (plains)	201.6	1972

Key: a. Adult fish high yield records (yields per mu)
b. 750 (mountain region 800 meters above sea level)

It has been true nevertheless that when quite a few reservoirs were built, insufficient consideration was given to all-around benefits that could be gained. They are without a clean foundation and lack fishing industry equipment such as equipment to screen fish off and pools for fry. As a result in 1977 only 58 percent of the province's reservoirs were being used for the rearing of fish and output of adult fish from most reservoirs was neither high nor consistent. Thus greater efforts must be made to develop the reservoir fishing industry.

(5) Development of Suburban Pisiculture To Raise the Level of Urban Self-Sufficiency in Fish

Hubei Province is renowned in both China and abroad for its freshwater fish varieties and its processed products. However, as a result of the rapid development of socialist construction and the constant growth of urban population, plus increases in exports, the conflict between supply and demand has become ever more pronounced. During the past 10 years or so, Wuhan City's annual output of fresh fish has hovered around 8 to 10 million jin. In terms of the city's population, this has meant only 3 to 4 jin per person per year. The energetic efforts made in a spirit of self-reliance by the people of all cities in the province to transform shallow lakes and wasteland flats, abandoned river beds, lowlying areas and low yield waterlogged fields, have paid off in a preliminary way. In 1972, Wuhan City began active building of ponds for intensive rearing of fish. After six winters and springs of effort, by 1977 the city had built 40,000 mu of fish ponds for the intensive rearing of fish, providing an output of 12 million jin of adult fish. As a result, the suburbs' gross output of adult fish was more than 20 million jin (not including Wuchang and Hanyang Counties), which was double the 1971 output, bringing to a close the hovering situation in production of aquatic products in the suburbs that had endured for 10 years with no forward movement. Formerly people in Shashi City "lived along the Chang Jiang, but had to turn elsewhere to get fish to eat." In recent years, however, the city has actively built a suburban fishing industry base, and in 1977 the supply of fresh fish averaged 6.4 jin per capita. Now, every city in the province is bending efforts toward the rearing of fish in the suburbs and to steadily increasing urban self-sufficiency in fresh fish.

In addition, in recent years the province has had initial success in experiments with the rearing of fish in net cages in the Bailian He and the Fuqiao He to blaze a new trail in development of fishing industry production.

Fourth Section. Burgeoning of Commune and Brigade Enterprises

Hubei Province has operated a group of commune and brigade enterprises ever since the early period of people's commune formation. Following the first national agricultural conference on learning from Dazhai in 1975, the province's commune and brigade enterprises developed very greatly. Today, every commune in the province and more than 98 percent of production brigades operate enterprises, the total numbering more than 111,000 and employing 1.62 million people, 1.44 million of whom work part time as workers and part time as peasants. In 1978, gross output value of the province's commune and brigade enterprises totaled 1.93 billion yuan, more than three times the 450 million yuan of 1974. They have risen from accounting for 7.6 percent of the tri-level people's commune economy in 1974 to 25.9 percent. A group of counties, communes and brigades that have developed rapidly and have a high output value has emerged from among those that have gone all out in development of enterprises. Commune and brigade enterprises with an output value of more than 50 million yuan in 1978 included the Hongshan district of Wuhan City, plus Mianyang, Hanyang, Tianmen, Daye, Huangpi, Xinzhou, Echeng, Xishui and Jianli Counties, with the Hongshan district of Wuhan City, and Mianyang, Hanyang, Tianmen and Daye Counties each having a gross output value of more than 70 million yuan. Communes with an output value of more than 10 million yuan were the Hongshan district of Wuhan City, Baiguo Commune in Macheng County, Xinnong Commune and Zhuru Commune in Hanyang County and Baoan Commune in Daye County. Production brigades with an output value of more than 1 million yuan were Hongxing Production Brigade in Jiangti Commune, Hongshan district, Wuhan City, Donggang Production Brigade in Huashan Commune, Gaihu Production Brigade in Gedian Commune, Echeng County and Xiaoji Brigade in Daji Commune, Hanyang County.

In the development of commune and brigade enterprises, Hubei Province has pursued mostly a policy of serving agricultural production. The province has a total of more than 1,800 commune farm machine and implement plants employing more than 75,000 people. These plants take care of more than 95 percent of the production of medium size and small farm implements and more than 60 percent of repairs on farm machines and implements. In 1978, they produced more than 33 million individual medium and small size farm implements made of iron, wood and bamboo, more than 35,000 small farm machines and semimechanized improved farm machines, and 11.9 million farm machine spare parts.

Commune and brigade enterprises take care of the processing of large amounts of agricultural sideline products and specialty products such as grain, cotton and edible oil. About 70 percent of the province's cotton ginning and 60 percent of its oil crushing is done by commune and brigade enterprises. As a result of the province's rapid expansion of commune and brigade farming and breeding in recent years, supplies of commodities have increased more and more. In 1978, the province's commune and brigade enterprises produced 150,000 dan of tea, which was 44 percent of the province's total output, and 80 million jin of fresh fish, which was one-third the province's total output. Commune and brigade enterprises also turned out a certain quantity of commonly used hardware items, bamboo and wooden products, pottery and porcelain,

plaited coir fiber, grasses and willow branches, clothing, shoes and hats, stationary, and arts and crafts items. In addition to supplying domestic markets, they provided goods for export.

Commune and brigade enterprises also provided substantial quantities of raw materials, fuels and construction materials needed by the state for socialist construction endeavors. In 1978, commune and brigade enterprises produced 2.1 million tons of raw coal, which was one-third the total amount of coal produced in the province, 500,000 tons of iron ore, which was 45.5 percent of the province's local industry iron ore output, 7,287 tons of sulfur, or 57 percent of the province's gross output, more than 150 million kilowatt hours of electric power, or 46 percent of the total electric power generated by small hydropower stations in the province, and more than 2.9 billion bricks or 50 percent of the province's gross output.

Commune enterprises played a marked role in the accumulation of funds to advance development of agricultural production. In 1978, commune and brigade enterprises accumulated a total of 290 million yuan, 107 million yuan of which was used directly in agricultural production, exceeding by 100 percent the amount of state investment in support of people's communes in Hubei Province. Revenues paid the state by commune and brigade enterprises also increased year by year reaching more than 172 million yuan in 1978.

In short, the burgeoning of commune and brigade enterprises has unfolded magnificent prospects for further use of local natural resources, for the strengthening of the collective economy, for hastening the modernization of agriculture, and for gradually making the transition from small collectives to large collectives and the industrialization of communes.

Part II. Agricultural Regions

The province's terrain is complex; resources are abundant; the state of the natural economy differs from place to place; and there are very great differences in conditions for development of agriculture. Hastening development of the province's agricultural production requires a division into areas and a designation of tracts, plus use of tailored guidance in order to proceed from realities as they exist in each region, to come to grips with major contradictions, to set a course for development, and to propose genuinely workable measures, the better to implement the program of "taking grain as the key link with all-around development, adaptation of general methods to specific situations and the right amount of centralization" for the gradual building of all kinds of agricultural areas with their own individual characteristics to make it possible to obtain fairly high economic benefits.

On the basis of the different natural conditions in each region, and the existing foundation in agricultural resources, economic circumstances, as well as the potential for production, and prospects for development, the entire province may be divided into seven major agricultural areas as follows: The Jianghan Plain region, the central Hubei hill region, the northern Hubei uplands region, the eastern Hubei low mountain and hill region, the southeastern Hubei low mountain and hill region, the southwestern Hubei mountain region, and the northwestern Hubei mountain region (see Figure 14 [not included in original text]). Because of insufficient surveys and research, and very incomplete understanding of circumstances, this area division is very tentative. It is simply a preliminary idea put forward for consideration by all concerned.

Chapter 3. The Jianghan Plain Region

The Jianghan Plain region is located in the south central part of the province and follows the Chang Jiang from the west toward the east through Jiangling, Songci, Gongan, Shishou, Jianli, Honghu, Mianyang, Tianmen, Qianjiang, Shashi, Huanggang, Xinzhou, Xishui, Jinchun, Guangji, Huangmei, Xiaogan, Huangpi, Yunmeng, Hanchuan, Echeng, Jiayu, Zhijiang, Dangyang and the suburbs of Wuhan City, plus Hanyang and Wuchang--a total of 27 counties and cities.[1] This region's agricultural production holds an important position in Hubei Province as well as nationally. Most of the nationally prescribed Jianghan Plain commodity grain base, one of 12 key commodity grain bases in the country, lies in this region. In 1987, this region's output accounted for 46.95 percent of the province's total grain output, 71.45 percent of its cotton output, 42.11 percent of its oil-bearing crops output, 40.09 percent of the number of live hogs in inventory, and 71.45 percent of the adult fish output.

Table 3-1 Jianghan Plain Region Basic Situation (1978)

Units: 10,000 mu; 10,000 people

		Percent of province total
Total area	7,389.91	26.29
Cultivated land		
Total	2,487.79	44.02
Wetlands	1,439.56	48.97
Drylands	1,048.23	38.64
Total population	2,149.77	47.27
Agricultural population	1,743.64	44.66
Average amount of cultivated land (mu) per capita of agricultural population	1.43	

1. The Jianghan Plain commodity grain base includes 12 counties in Jingzhou Prefecture (namely Jiangling, Songci, Gongan, Shishou, Jianli, Honghu, Mianyang, Tianmen, Qianjiang, Jingmen, Zhongxiang and Jingshan), and 18 state farms as well as 3½ counties in the eastern part of Yichang Prefecture (namely, Dangyang, Zhijiang, Yuanan and the eastern part of Yichang County).

First Section. General Discussion

1. Abundant Water, Heat and Soil Resources

In the Jianghan Plain region, the climate is warm and damp, the land is vast and flat, the soil is deep and fertile, and water, heat and soil resources are very abundant, providing superior natural conditions for the development of agricultural production.

(1) Climate Is Warm and Damp, Water and Heat Resources Abundant

This region has abundant heat resources and a long crop growing period. Its frost-free period numbers 250-280 days, and it has 230-240 days of active growing season when average daily temperatures are stable at 10°C. During the period of active crop growth, it has a cumulative temperature of 5,100-5,400°C, and the safe growing season for double-cropped rice is 180-190 days. During this period cumulative temperature ranges from 4,200 to 4,600°C. Consequently, everywhere in this region, and particularly everywhere along the Chang Jiang in the eastern part of it, heat loving crops can be grown, and favorable conditions exist for the growing of cotton, double crops of rice and development of a three crop system.

Rainfall is copious in this region, averaging 1,100-1,400 millimeters a year. It is also concentrated mostly during the growing season, with an average of more than 600 millimeters falling everywhere between April and July. In most years, rainfall averages more than 500 meters, and no less than 350 millimeters even in minimum years. This is extremely favorable for the growth of crops, particularly early rice. The water that early rice needs during its reproductive stage (approximately 450-600 millimeters) is guaranteed in most years. However, in the eastern part of the region, there is too much during spring in some years, and this is bad for late stage growth of crops harvested in summer. Long periods of cloudy, rainy weather in the fall also hurt ripening and picking of cotton.

This region also gets considerable sunshine at the rate of 1,800-2,100 hours each year. This is between 42 and 49 percent of the total possible hours of sunshine for a year and an average of more than 5 hours daily.

However, weather changes are fairly tricky in this region. Weather of varying degrees of destructiveness occurs virtually every year. For example, the low temperatures and rainy or overcast weather of spring and fall, the waterlogging of summer, and the drought of the dog days of summer or in the fall seriously hurt continued increases in agricultural output. As a result of long experience with agricultural production, the broad masses of commune members understand and know how to handle changes in weather patterns. They grasp "the warm tip of the cold tail" of winter to do early planting, use plastic sheeting to grow seedlings or else grow seedlings hydroponically in hot houses, and use irrigation water to regulate temperature and change the farmland microclimate, thereby preventing or reducing damage caused to early rice through low

temperatures and the rotting of seedlings. Depending on differences between one place and another, they know how to manage the safe full heading period for the second late crop, making the full heading period for the second late rice crop fall between 20-25 September, thereby avoiding autumn cold and harvesting a bumper crop. Energetic building of water conservancy, drainage and irrigation projects, and major farmland capital construction efforts have improved capabilities to withstand natural disasters such as floods, waterlogging and drought.

(2) A Broad Plain Filled With Rivers and Lakes

Except for the northern and eastern parts of this region and its western fringes where there are uplands and hills, most of this region is the extremely flat Jianghan alluvial plain.

The Jianghan alluvial plan is part of two lacustrine plains. Generally it extends from the Zhi Jiang in the west and from Zhongxiang in the north, connects with the plain of Dongting Hu in the south and extends eastward to the Chang Jiang. The Chang Jiang cuts across the entire region from west to east, and the Han Jiang flows into the region from north to south. At their confluence, a myriad of large and small streams are formed, and the alluvium of both has formed a vast expanse of fertile land as far as the eye can see. The whole plain tilts gently from the northwest to the southeast. It descends from a height of about 40 meters in the northwest to less than 30 meters in the southeast. At Hankou it is only 23 meters and along the Chang Jiang at Huangmei it is less than 200 meters. Except for some isolated hills scattered here and there in the region[1] like tiny islands sticking up above the surface of the sea, most of the plain is less than 35 meters high and the terrain is extremely flat. The soaring plain alternates in belts with lake and marsh lowlands. On the flatlands outside the Jianghan great dikes, in particular, the land has risen as a result of silting by the river current (the land surface reaching a height of 38-40 meters, the plain within the Jianghan great dike being a general 3-6 meters lower than the flatlands outside the dike, and the surface of the land tilting inward). Thanks to the fairly high terrain, drainage of these soaring plains is fairly easy; the ground water table is fairly low; and the alluvial soil is extremely friable, most of it having the quality of gravel or pulverized sand, making this region the most important cotton growing region in the whole province. As both banks of the rivers have gradually risen through silting, the area between rivers and the fringes of the uplands have become relative lowlands. Because of the convergence of waters here, this area abounds in lakes and marshes. During the period immediately following liberation, there were 1,066 lakes here covering an area of 12.5 million mu or one-sixth of the region's total land area. The density of lakes and the crisscrossing of the land by streams produced a scene of one vast marshland. Here the land is no higher than 25-30 meters or lower. Because of the constant water stagnation, the water table is very high or even as high as the surface water. The soil is heavy and wetlands numerous, making it a major commodity grain growing area.

1. Like Huangpeng Shan, Dajun Shan, Xiaojun Shan, She Shan, etc.

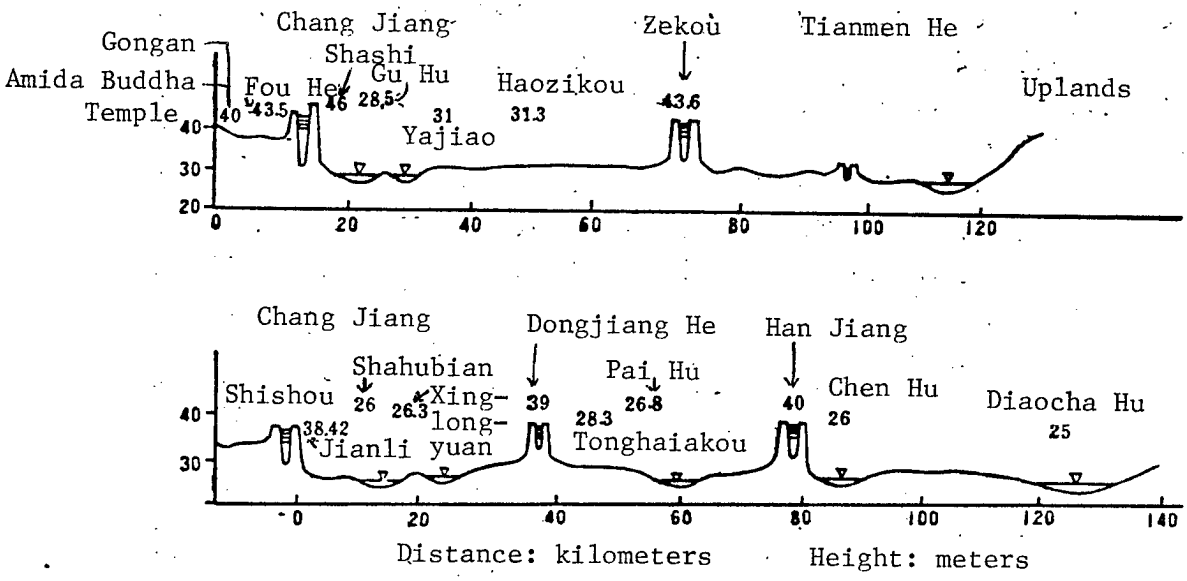

Figure 15. Cross Section of a Representative Portion of the Jianghan Plain

The Jianghan Plain is one of the regions in the country with the largest number of lakes. Here lake bottoms are shallow and flat, the water in the lakes not very deep and the water quality very good. They contain much food for aquatic animals, and aquatic products are extremely plentiful. Most of these lakes are in a declining stage, however, and water grasses grow in profusion in the shallows of many lakes. The lake area is shrinking and becoming marshy. During the season when water ceases to flow in rivers, the loss of water from many of these lakes turns them into seasonal marshlands, and the shallowness of many of these lakes makes them marshlike lakes. The trend of their natural change is toward gradual filling with silt, break up and disappearance. These lakes all have a deep layer of silk. Their bottoms are composed of soft, black mud that abounds in organic matter. These tracts of flat land lend themselves to machine cultivation. Proper development of lake wastelands to expand the amount of cultivated land plays a definite role in the development of agricultural production. These lakes have always been bases for the production of aquatic products for the Jianghan Plain, however, and their role in regulating and impounding water has been of extremely great significance in the prevention of flood, waterlogging and drought disasters. Thus, it is necessary to plan in a centralized way for all-around harnessing of the lakes.

Surrounding the flat alluvial plain in this region are uplands about 50 meters in height with a soil layer composed of red or brown subclay soil that ranges from several to more than 10 meters thick. In terms of terrain configuration these uplands are usually classified as part of the plain (including the undulating plain and the hill and dale plain). However, in terms of farmland water conservancy and soil utilization, they obviously differ from the alluvial plain and are, to a certain extent, similar to the hills. Their elevation is less than 20 meters, and some are no more than 10 meters high. They roll gently, hills alternating with dales (shallow valleys), arranged in rows

and radiating in the direction of the alluvial plain to the east. Valleys between the hills are generally shallow and broad, the tops of the hills flat, and the slopes of the hills gentle, providing rather good conditions for their reclamation for agriculture. Right now, except for the growing of some dryland crops atop the hills, the slopes and the dales have been developed as wetlands. This area is checkered with farmland, and agriculture is well developed. In the eastern uplands where population is large relative to cultivated land, farming is done intensively; the level of production is fairly high, and it is a region of high grain and cotton yields.

(3) Thick and Fertile Soil and Plentiful Soil Resources

This region is the agricultural region in the province with the best soil conditions. Most of the cultivated land is alluvium, which is generally rich in organic matter and mineral nutrients. It has very high natural fertility, and is also friable and fairly light. Its physical properties are very good, suiting it to farming. Fertilization brings quick results, and it is suitable for the growing of cotton, grain and oil-bearing crops. Because the oily sandy soil and the ordinary soil have naturally high fertility and strong ability to conserve water and fertility, fertilization brings fast results, and crop yields are high.

The soil along the northern fringe of hills in this region is mostly baishan soil or magan soil. Baishan soil is found mostly on the lower slopes of hills or on flat land. This soil is friable and fertile, readily cultivatable, shows good results when fertilized, and is suitable for the growing of all sorts of wetland and dryland crops. Magan soil is found mostly on the upper slopes and tops of hills. It is heavy and firm and difficult to plow or harrow. But the soil level is usually fairly thick, and it is fairly fertile. In some cases organic content is as high as 2 percent. With sensible farming, after a certain amount of improvement, magan soil makes a fairly good wetland soil. This region also has some sandy loam, which is found mostly in the upland regions of Xishui and Huanggang Counties. Sandy loam is formed from weathered gneiss and mica schist and their cliff debris. This soil forms a thick layer and is friable, and it is always sandy or loam-like in quality, which suits it for plowing and harrowing and for drainage of water. It is good for deep plowing and development of crop root systems. Results from fertilization are also pronounced. Sandy loam has a fairly low organic content and a complete nitrogen content, however. Furthermore, since it is so coarse and friable, it is extremely prone to serious scouring. It requires the addition of argilla and organic fertilizer to increase soil fertility. In addition, water and soil conservation are required to prevent erosion.

The region's lake wastelands that have been developed have a thick soil layer, and their soil is fertile, consisting mostly of lacustrine argilla and some alluvial oily gravel soil. This soil has an organic content one to two times higher than ordinary soil, and its complete nitrogen, phosphate, and potash content is also very high (see Table 3-2). This soil is one of the province's most important soil resources. Some state-owned farms have been built on the development and use of lake wastelands in this region.

Table 3-2 Lake Wasteland Soil Chemical and Physical Properties

Name of soil	Lacustrine agrilla	Limestone type oily sandy soil
pH		
Water soaked	7.3	7.3 - 7.6
Potassium nitrate	7.2	-
Organic matter (percent)	5.5	2.5 - 3.0
Complete nitrogen (percent)	0.24	0.11- 0.19
Complete phosphate (percent)	0.11	
Sample points	Dongxi Hu Farm, Wuhan	Zongkou Farm in Qianjiang

In addition, about 1.5 million mu of wasteland flats lay along rivers and many of them could be opened to cultivation once their soil had been improved.

2. Tremendous Achievements in Water Conservancy Construction and in Agricultural Production

Since the founding of the People's Republic, earthshaking changes have taken place on the Jianghan Plain. The grassy shallows and wasteland flats that formerly produced no harvest in 9 years out of 10 have now become seas of cotton and storehouses of grain that produce bumper crops year after year.

(1) Water Conservancy Construction

1. Locking the Main Entrance To Triumph Over Floodwaters

Before liberation, the dikes of the Chang Jiang and the Han Jiang were riddled with holes and flood prevention standards were very low. In addition, the rivers were connected directly to the lakes so every time there was high water, even if the dikes did not breach, frequently serious disasters resulted because of the rivers' reverse irrigation. "Locking the main door to triumph over flood waters" had been a hope cherished for thousands of years by the people of the Jianghan Plain who had been deeply affected by flood disasters. This hope finally became reality following liberation. In 1952, the Jing Jiang flood dispersal project was built, and in 1956 the Dujiatai flood dispersal project was built on the Han Jiang. In addition repairs and strengthening were carried out along the approximately 6,000 kilometer long dikes (including more than 1,400 kilometers of dikes along the Chang Jiang, and more than 700 kilometers of dike along the Han Jiang). At the same time more than 1,800 floodgates for water drainage and irrigation were built in the dikes along the rivers. In this way water in the rivers was separated from water outside the rivers and both irrigation and drainage could be carried out. This vastly improved internal flood prevention and drainage of stagnant water on the plain, as well as conditions for the diversion of water for irrigation.

In order to further insure the safety of all key sections of the great dikes of the Chang Jiang and Han Jiang, a huge project to prevent floods and drain waterlogging is currently being built on the Hong Hu.

2. Impounding Floodwaters in the Mountains for Irrigation

Hills rise and fall around this region and the terrain in the middle is low and flat. As a result, rivers and lakes flood below while mountain torrents above converge and pour down. Since liberation, countless projects for the impounding of water have been built on medium size and small streams in the mountains and hills that ring the area. Large reservoirs such as those on the Bailian He, the Zhang He and the Weishui, as well as medium size reservoirs such as the Meichuan, Niuche He and Xiajiasi reservoirs have been built in addition to countless small reservoirs and dammed ponds. Today reservoirs and ponds dot the uplands like stars in the heavens and canals intersect in a network to form a virtual water storage system that combines the large, the medium size and the small. This has not only greatly strengthened upland region capabilities to withstand drought, but has also effectively blocked runoff to reduce the threat of flood disasters on the plain lake region in the lower reaches.

3. Separating Rivers From Lakes and Dividing Waters To Flow Into Rivers

The area from which waters flow into this region is vast. In order to further reduce the volume of water entering the lakes, in recent years major actions have been taken to separate rivers from lakes, to drain away high water, and to divide up waters flowing into rivers. For example, changing the course of the Fu He in 1959 shunted waters arriving from an 8,321 square kilometer area. The Hanbei He project of 1970 diverted incoming waters from the Tianmen He, the Gui Shui and the Dafu Shui over a 6,500 square kilometer area. In 1973, changing the course of rivers to reverse flow caused incoming waters from a 1,873 kilometer area to flow directly into the Chang Jiang, thus reducing waterlogging of the plain lake region. At the same time, rivers and lakes were separated by building flood gates to effect control. This improved the degree to which harvests could be guaranteed from lowlying farmlands prone to waterlogging, and fundamentally changed the impotence of the people in the face of flooding from rivers and lakes. These measures set the stage for all-around harnessing of the lakes.

4. Taking Drainage as the Key in a Combination of Drainage and Irrigation

As a result of many years of effort, several thousand kilometers of main drainage and irrigation canals have been dug and dredged. In the four lakes region of Jingzhou, for example, not only was the existing bed of the Jing He used, but a main canal 126 kilometers long was also dug. In addition, an eastern trunk canal, a western trunk canal, field control canals and a few score drainage and irrigation canals of other kinds were built for a complete transformation of the existing water system. This was done in conjunction with the building of drainage and irrigation sluice gates in culverts along the river and around lakes. Today, it is possible to drain water at the rate of more than 14,000 cubic meters per second, and water diversion capacity is

more than 4.6 billion cubic meters. A fairly complete gravity drainage and irrigation system has been preliminarily formed on the Jianghan Plain. This has greatly improved the draining of waterlogging and diversion of water for irrigation, and it has also helped development of navigation.

However, since the water level in rivers rises after May, the flood gates along the rivers are shut. During this season, water on the plain cannot drain away by gravity. Furthermore, because river water levels are low prior to May, water cannot be easily diverted through numerous gates. In order to turn around this passive situation of spring drought and summer waterlogging, another group of large hydropower drainage and irrigation stations were built. Examples include the Chen Hu pumping station on the north shore of the Han Jiang, the Han Chuan No 1 station, the Mianyang pumping station to drain lake water, the Luoshan pumping station in Jianli, the Nantaogou and Gaotankou pumping stations on Hong Hu and the Jinkou pumping station at Wuchang. Located at 23 sites, these large electric power irrigation and drainage stations work together with small pumping stations at 500 places and have an installed capacity of more than 342,000 kilowatts, can raise and drain a flow of 3,412 meters per second, and can drain a 7.35 million mu area. Construction of a combination of large, medium size and small electric power drainage and irrigation station network has been the first step in making drainage possible whenever waterlogging occurs and making irrigation possible when drought occurs. As a result, the threat of flood and drought disasters has been greatly reduced, and consistently high yields from this region's agriculture are better assured.

(2) Agricultural Production

Following liberation, agricultural production developed fairly rapidly in this region. In 1978 the region's grain output reached 16.202 billion jin, which was more than three times the 1949 output. Cotton output was 5,371,600 dan, more than seven times the 1949 amount. Oil-bearing crop output also increased (see Table 3-3).

In 1978, the region's grain yields averaged 897 jin per mu (figured on the basis of an 18.07 million mu grain growing area). In Xishui, Huanggang, Guangji, Jinchun, Yunmeng, Xinzhou and Huangpi, yields were more than 1,000 jin per mu. The area's cotton yields averaged 107 jin per mu, with Xinzhou and Yunmeng Counties producing yields of more than 150 jin per mu.

Table 3-3 Jianghan Plain Grain, Cotton and Oil Output

Year	Gross grain output (100 million jin)	Gross cotton output (10,000 dan)	Gross oil-bearing crop output (10,000 jin)
1949	52.87	76.35	146.53
1957	88.20	302.22	238.15
1965	119.99	683.15	142.44
1978	162.02	537.16	199.71

This region's rapid development of agricultural production has been closely related to major efforts at restructuring the farming system. During the period immediately following liberation, two crops of rice were grown in only an extremely small number of places. Today, however, the region has become a major double rice crop growing area. The double rice crop area has expanded particularly rapidly during the last 10-odd years. In 1978, the wetland double rice crop area had increased to about 70 percent from the 3 percent of 1949 (see Table 3-4). This restructuring made further use of the region's water and heat resources, and took further advantage of the soil's potential to produce increased yields, giving powerful impetus to rapid increase in grain production.

Table 3-4 Growth in Two Rice Crops on the Jianghan Plain

Year	Wetland area (10,000 mu)	Double rice crop area (10,000 mu)	Percent of wetlands used for growing two crops of rice
1949	1,361.02	49.76	3.66
1957	1,462.54	267.93	18.32
1966	1,503.51	583.96	38.84
1978	1,439.86	1,005.88	69.86

The Jianghan Plain is Hubei Province's cotton growing area and it is also one of the country's major cotton growing areas. It has 6.4 million mu of cotton fields. The two cotton growing areas of eastern Hubei and the Jianghan Plain contain 70 percent of the province's cotton fields. Cotton fields lay along both banks of rivers, and are concentrated largely in counties along the banks of the Chang Jiang and the Han Jiang, as well as in Xinzhou County in eastern Hubei. In these areas, cotton is grown on 40-60 percent of the cultivated land and on more than 80 percent of the land in some communes.

The cotton field area of this region has increased more than 80 percent from what it had been on the eve of liberation and cotton output has increased between eight and nine-fold. The quality of cotton has also risen markedly.

Most of the cotton fields in this region are two crop fields in which cotton is intercropped with wheat, barley or naked barley (or broad beans). Formerly, cotton was grown mostly as the crop following wheat in eastern Hubei. In Xinzhou County, for example, cotton followed wheat (wheat being planted as a winter crop) on about 70 percent of the land). In the Jianghan cotton growing area, on the other hand, cotton followed barley or broad beans for the most part. In Tianmen, Mianyang and Qianjiang Counties along the Han Jiang, cotton was grown after barley on between 40 and 50 percent of the fields. Along the Chang Jiang in Gongan, Shishou, Jianli and Honghu Counties, cotton was grown after broad beans on 35 to 40 percent of the land. Recently, with expansion of the cotton field area, improvement in cotton growing techniques, and development of farmland capital construction, the growing of cotton as a crop following wheat has steadily increased and now holds a commanding position. This has played an important role in increasing the degree of self-sufficiency in cotton and grain.

The Jianghan Plain has historically been noted in the province for its production of aquatic products. In 1977, adult fish output reached 157 million jin, or 67 percent of the province's total output. In this area, lotus, water fowl and other aquatic products also proliferate and many of them are major export items. This is also one of China's noted fish fry producing areas. There are over 20 major spawning grounds for snail carp, grass carp, silver carp and bream here. Formerly, the fishing industry here relied mostly on catches and virtually no artificial rearing of fish was done. The vast expanses of rivers and lakes were not used to the full and production was extremely inconsistent. In recent years with development of water conservancy construction plus harnessing rivers and lakes, great efforts have been made in artificial rearing and the state of aquatic products production is rapidly changing.

Chapter 4. Central Hubei Hill Region

The central Hubei Hill region lies in the middle of the province. To the northeast lies the Tongbai Shan watershed and the border with Henan Province. To the east and southeast, the region borders the northeastern low mountain and hill region of the province and the Jianghan Plain. In the west and northwest, it abuts the province's northwestern mountain region and the province's northern uplands. This region lies in a northeast-southwest direction and includes Jingmen, Zhongxiang and Jingshan Counties in Jingzhou Prefecture, Yingcheng, Anlu and Yingshan Counties in Xiaogan Prefecture and Suixian and Yicheng Counties in Xiangyang Prefecture.

Table 4-1 Basic Situation in the Central Hubei Hill Region (1978)

Units: 10,000 mu; 10,000 people

		Percent of province total
Total area	3,995.85	14.21
Cultivated land area--Total	847.08	14.99
Wetlands	592.97	20.17
Drylands	254.11	9.37
Total population	573.25	12.53
Agricultural population	514.35	13.17
Average amount of cultivated land per capita of agricultural population	1.65	

It is in this region that most of the province's grain is grown, and though this region has historically provided the state with less commodity grain than the Jianghan Plain, it holds first place in the province in per capita amount of commodity grain provided. The region has plentiful land resources and a very great potential exists for development of farming, forestry and animal husbandry, which will require building it into a commodity grain base for the province that combines farming, forestry and animal husbandry.

First Section. General Discussion

1. Land Configuration and Soil Resources

Most of the Hubei central hill region is a part of the Huaiyang mountain region, whose central zone is dominated by the low mountains and hills of the Dahong Shan and includes mostly Yicheng, Jingshan, Anlu Counties and southern Suixian County, northern Yingcheng County and the eastern part of the Han Jiang in Zhongxiang County. The northeastern part of the region is the southern foothills of Tongbai Shan, which includes Yingshan and the northern part of Suixian County. In the southwest is the southeastern foothills of Jing Shan, which includes mostly the western part of the Han Jiang in Zhongxiang County and most of northwestern Jingmen County. This region has low mountains, hills and plains, but hills predominate accounting for 60 percent of the total area (see Table 4-2).

Table 4-2 Statistical Table Showing Major Kinds of Terrain in the Hubei Central Hill Region

Units: 10,000 mu

	Total area	Mountainland		Hills		Plain	
		Area	Percent	Area	Percent	Area	Percent
Total	3,995.85	1,047.24	26	2,228.66	56	719.95	18
Jingmen	633.30	116.53	18.4	466.74	73.7	50.03	7.9
Zhongxiang	667.50	186.90	28	293.70	44	186.90	28
Jingshan	585.75	370.19	63.2	168.11	28.7	47.45	8.1
Suixian	1,050.00	172.20	16.4	668.85	63.7	208.95	19.9
Yicheng	283.50			133.81	47.2	149.69	52.8
Yingshan	401.25	120.78	30.1	270.44	67.4	10.03	2.5
Anlu	201.60	80.64	40	84.67	42	36.29	18
Yingcheng	172.95			142.34	82.3	30.61	17.7

The Dahong Shan is the watershed between the Han Shui in this region. Except for the main peak of Dahong Shan, which is 1,055 meters above sea level, most of the remainder of the mountain consists of hills at an elevation of less than 500 meters above sea level. At the conjunction of Zhongxiang, Jingshan and Suixian Counties, the elevation above sea level is a little over 500 meters, and this is the main timber producing part of the region. Both north and south from the Dahong Shan watershed are low mountains, low hills, river valleys and plains. In the north, the land consists mostly of limestone, and in the southernmost part around Jingshan, there are also shale outcroppings. Since shale is fairly soft and easily weathered, the shale areas of southern

Suixian and Jingshan, and part of Zhongxiang have broad valleys and greatly sloping topography, and most of the cultivated land is concentrated here. In the Yunshui river valley and the southern foothills of the Dahong Shan, the relative elevation of the red rock hills is about 40 meters and the red soil uplands are dissected at only about 20 meters. This is the main farming area at the present time.

In the southern foothills of the Tongbai Shan, the terrain appears broken up and low. The mountain itself is a medium low mountainland made up of granite and metamorphic rock of recent origin on which erosion is not extremely apparent. In the area around Yingshan is a large expanse of monadnocks and eroded red soil uplands. Most of the streams flow parallel to each other. The Zha Shui, Jue Shui, Piao Shui and Yingshan He, all of which follow the mountain slopes and flow from north to south enter the Yun Shui to form the Yun Shui Plain. The alluvium on the plain is not very thick, and in many places one can see schist and shale outcroppings. In normal years, the flow from these streams is sufficient for irrigation purposes.

The area to the west of the Han Jiang in this region is a part of the southeastern foothills of the Jing Shan range. On the river valley plains formed by alluvium on both banks of the Han Shui and in the Chang Hu region of southern Jingmen, the terrain is fairly flat, with the lowest point being about 30 meters above sea level. Here mostly paddy rice, cotton and wheat are grown. The central highlands are undulating hills alternating with dales, and mostly paddy rice is grown here. The low mountains and hills of the northwest are crisscrossed with mountain ranges and shallow valleys and lowlands are narrow. The mountainlands are 200-odd meters above sea level and a maximum of 665 meters high producing most paddy rice, wheat and timber.

This region's plentiful land resources have not yet been fully developed. Numerous gentle slopes, rolling uplands and scattered, perfectly round low mountains await improvement for use. A survey done by Jingmen County on production brigade land utilization (see Table 4-3) showed a utilization rate of only 50 to 65 percent for most low hill and plain areas. In low mountain areas where water and soil conditions are relatively poor, there is usually little cultivated land, but uncultivated land suitable for forests or animal husbandry is fairly plentiful. It can be used for development of various kinds of forestry and animal husbandry bases. Forestry survey statistics from 1975 show a total of 3,735,100 mu of barren mountains and wastelands in this region (see Table 4-4), and about 100,000 mu of sandy wasteland. The barren mountain area of Suixian, Jingshan and Zhongxiang Counties accounts for 65 percent of the total in the region. Mostly it is found in the Dahong Shan where the three counties meet.

2. Agricultural Climatic Conditions

The central hill region of Hubei gets a fair amount of sunshine, an average of 1,900-2,200 hours per year. Most places get more than 2,000 hours. Solar energy is fairly plentiful, the total amount of solar radiation reaching between 110 and 120 kilocalories per square centimeter. Photosynthesis potential is about 13,800 to 14,900 jin per mu.

Table 4-3 Current Land Utilization by Six Jingmen County Production Brigades

Units: Shimu

Name of production brigade	Total area	Land under cultivation	Utilization rate (%)	Proportions of wetlands, drylands: Wetlands (%)	Proportions of wetlands, drylands: Drylands (%)	Wetlands distribution
Guanghua	6,404	3,894	60.3	87.1	12.9	主要分布在塝田 (a)
Anping	7,095	4,857	63.2	94.0	6.0	主要分布在冲、塝田，其次为岗田(b)
Minzhu	6,255	3,743	59.8	91.6	8.4	主要分布在岗田，其次为冲、塝田(c)
Yandian	5,480	3,559	65.0	87.5	12.5	主要分布在岗田，其次为塝、冲田(d)
Douli	10,003	4,831	48.3	67.6	32.4	主要分布在冲田，其次为岗、塝田(e)
Yangtian	4,725	2,460	52.2	84.0	16.0	主要分布在冲田，其次为岗、塝田(f)

Note: Cultivated land means actual area, which is 15 percent more than recorded area, on average. Correction coefficient is (+) 15 to 20 percent.

Key:

a. Mostly in edges of fields
b. Mostly in hill area flatland fields and edges of fields and secondly in upland fields
c. Mostly in upland fields and secondly in edges of fields and in hill area flatland fields
d. Mostly in hill area flatland fields and secondly in uplands and edges of fields
e. Mostly in hill area flatland fields and secondly in uplands and edges of fields

Table 4-4 Hubei Central Hill Region Barren Mountain and Wasteland Area Statistics

Barren mountain & wasteland area (10,000 mu)	Communes having more than 10,000 mu of barren mountains and wastelands: 10,000-20,000 mu	30,000-50,000 mu	60,000-70,000 mu	80,000-100,000 mu	More than 100,000 mu
Jingmen	28.01	3	6			
Zhongxiang	59.33	4	5	5		
Jingshan	69.08	3	6	2		
Suixian	113.55	15	5	4	2	1
Xicheng	47.92	3	4		1	1
Yingshan	34.17	5	4	2	1	
Anlu	16.70	6	3			
Yingcheng	2.59					
Heji	373.51	39	35	13	4	2

This region's annual temperature averages 15-16°C. The growing season during which average daily temperatures are greater than 10°C averages 230 days. Active cumulative temperatures during the growing season are 4,900-5,100°C. The frost-free period is 230-265 days. Though the crop growing season varies from south to north, throughout the region the crop growing season is fairly long, and heat conditions are fully able to satisfy the needs of agricultural production.

In this region, the climatic condition most unfavorable to agriculture is the frequent occurrence of drought. In some of the counties around Dahong Shan, in particular, the frequency of drought is greatest and the area is popularly known as a "drought nest." For a record of great drought years in the counties of this region, please see Table 4-5.

Table 4-5 Record of History of Droughts in the Hubei Central Hill Region

County	Beginning and ending years	Total number of years	Frequency of drought years	Frequency (number of years per occurrence)
Zhongxiang	A.D. 1027 - 1856	829	20	41
Jingmen	B.C. 235 - A.D. 1961	2,197	173	12.7
Jingshan	A.D. 1458 - 1878	420	21	20
Suixian	A.D. 1172 - 1856	680	16	43
Yicheng	A.D. 1168 - 1882	714	19	36
Yingshan	A.D. 1182 - 1856	672	31	22
Anlu	A.D. 1000 - 1908	908	40	22
Yingcheng	A.D. 1353 - 1877	342	30	11

In this region, summer droughts tend to be most frequent, followed by autumn drought. Drought records kept since liberation show more than 1 month's drought here each year, a winter or spring drought about once every 3 to 4 years, and a drought during the dog days of summer virtually twice every 3 years.

Particularly noteworthy is the tendency during the past 30 years for the frequency of drought to have increased in this region. According to statistics from Zhongxiang County, 24 droughts have occurred during this century, or an average of one every 2.6 years. This included 14 droughts during the 25-year period from 1953-1978, or an average of one drought every 1.8 years. Three times drought endured for 3 consecutive years (1951-1953, 1959-1961 and 1976-1978). During the past 20-odd years, in particular, the probability of a drought occurring has been greater than during the previous 10 years. Four great droughts that were widespread and calamitous have all occurred since 1958. For the Hubei central hill region, 1978 was a year of particularly severe drought. The drought lasted for a long time (the drought actually

having begun in the autumn of 1977) and affected a large area. Such a drought has rarely been seen during the past 100 years. Most of the area's primary tributaries to the Han Jiang and the Yun Shui stopped flowing; medium and small size reservoirs dried up, and large reservoirs contained only small amounts of stagnant water. In that year, high temperatures continued without letup from late June until late October without a single soaking rain occurring. During July and August, just at the time when crops need water for growth, the drought worsened. Only 10.3 millimeters, or 1/30th the normal rainfall for this period, fell. In September, when the drought was at its worst, the county had only slightly more than 14 million cubic meters on hand. This was only 3.3 percent of the total storage capacity of the county's water conservancy projects. An overwhelming majority of reservoirs and dammed ponds dried up; rivers stopped flowing, fields cracked, and crops withered. A 577,000 mu area of the province was disaster stricken. More than 25,000 mu of intermediate rice and 59,600 mu of late rice was killed by the drought. In some places, both people and livestock found it difficult to find drinking water.

The incidence of drought in this region is closely related to climatic conditions, topographical features, water conservancy facilities, hydrological characteristics, and soil quality. In most years precipitation in the Hubei central hill region averages 900-1,100 millimeters, which is no small amount. Furthermore, distribution of precipitation throughout the four seasons does not differ greatly from elsewhere throughout the province. The main problem here is the fairly great change in the amount of precipitation from one year to another. Analysis of meteorological data since the founding of the People's Republic shows a 1.3 to 2.2 fold difference between the years of greatest rainfall and the years of least rainfall. For example, in 1954, Yingshan received 1,581.4 millimeters of precipitation, while only 491.7 millimeters fell in 1978. The variation in rainfall from month to month is also very great. Take the amount of rainfall in Yingshan during July, for example. In a year of great rainfall (1968), it received 465 millimeters during July; in a year of scant rainfall (1959), it received less than 1 millimeter. Such an extremely inconsistent and tremendous change in the amount of precipitation is a major cause of drought in this region.

In this region, most of the precipitation falls during summer when between 400 and 500 millimeters falls. This is about 50 percent of the year's total rainfall. As much as 200-odd millimeters of rain may fall in a single day. Such an excessive concentration of precipitation ordinarily cannot be effectively used by fields, or stored by reservoirs, or supplied to crops. Thus, it flows away in the form of runoff, only to have drought frequently occur during the height of summer or in the fall.

Additionally, drought in the central hill region of Hubei is influended by natural geographical conditions. One is that this region's terrain is fairly low, and its river valley passageways increase the speed of air flow from south to north while weakening the perpendicular countercurrent or air flow, thus decreasing local chances for rainfall. Measurements show a fairly high wind speed here (annual wind speed averages about 3 meters per second), and

dry air, the annual average relative humidity being only about 75 percent except at Yingcheng, Jingmen and Jingshan on the southern end of the plain. The annual amount of evaporation is also the highest in the province. Thus, probabilities that drought will occur here are greater than elsewhere. A second is the small number of lakes, the slight amount of water surface, and the few forests in this area. All these conditions are major factors bringing on drought. Thirdly, in the hill region, the cultivated layer of soil is fairly shallow, so the ability of the cultivated layer to conserve water is poor. In addition, the lay of the land does not permit fullest effective use of precipitation. In order to reduce drought damage and make full use of light and heat resources, this region will not only have to undertake capital construction of its farmland, devote major efforts to the building of water conservancy, and tap water resources, but will also have to make major efforts in afforestation, build shelter forest belts, increase the vegetation cover rate, and do a good job of collecting and conserving water.

3. Grain Commodity Rate and Potential for Increased Output

The central hill region is one of the province's major grain growing areas. In 1978, 16 counties or one-third the counties in the region produced an average of more than 1,000 jin of grain per capita of agricultural population. Yicheng and Jingmen Counties produced approximately 1,400 jin of grain per capita of agricultural population, the highest amount in the province. Of the 19 communes in the province in which grain output per household averaged more than 10,000 jin, 14 were in this region. Of the communes in the province in which grain output averaged 1,200 per capita, 36 percent were in this region. In 1977, eight counties in the region had 1.027 billion jin of grain to market after making sales to the state. This was 44.56 percent of the total grain marketed by the province below the county level following sales to the state. Cumulative figures for the period 1953-1977 show 15.945 billion jin of grain for marketing after sales to the state for the region. This was 38 percent of the amount of grain marketed after sales to the state for the province below the county level. This region's grain commodity rate is also very high. In 1977, for example, the commodity grain rate for all counties was higher than the provincial average (see Table 4-6), with Jingmen and Jingshan Counties having the highest rate in the province.

Despite the present fairly high commodity grain rate for the Hubei central hill region, in terms of conditions in the region and prospects for its development, there is still a very great potential for further increases in grain output and the commodity grain rate.

First of all, the potential of existing cultivated land has not been used to the full. Though the amount of cultivated land per capita is large, the workforce is small; the degree of mechanization is low; farming is insufficiently intensive, and there is much room for improvement in grain yields per unit of area. In the area of farmland capital construction alone, currently wetlands are concentrated in hill regions, but irrigation problems have not been solved very well. Yingshan, Suixian, Jingmen, Zhongxiang and Jingshan Counties have more than 1 million mu not served by water conservancy. In a small number of other counties, leveling of the land and improvement of the soil to

Table 4-6 Central Hubei Hill Region Commodity Grain Rate Statistical Table (1977)

Units: 100 million jin

	Gross output of grain	Net commodity grain	Grain commodity rate (percent)
Grand total for province	321.76	50.33	15.64
Total	54.84	15.81	28.82
Yingshan	5.08	0.86	16.87
Anlu	3.91	0.76	19.34
Yingcheng	4.49	1.15	25.59
Jingmen	10.91	4.44	40.72
Zhongxiang	7.80	1.85	23.67
Jingshan	6.45	2.53	39.14
Suixian	11.08	2.76	24.90
Yicheng	5.11	1.47	28.75

transform low yield fields has not yet begun in earnest. There are still several hundred thousand mu of cold waterlogged fields in the region as well as large amounts of low yield fields where the land should be leveled and improvement continued. Secondly, this region has a large amount of barren hills and flat hills that are not properly used. Third, the region's grain output is unbalanced. In 1978, Suixian, the county in the region with the highest average grain yields, had 905 jin per mu; however, some counties harvested less than 800 jin per mu. Yields per mu of intermediate rice and summer grain in this region are higher than the provincial average; however, in some counties, they are below the provincial average. Within a single county, grain yields may vary greatly. Take Suixian County, for example. In 1978, yields varied by as much as 260 jin per mu for the area sown to grain, while yields per mu in some communes were lower than the provincial average. In addition, in 1978 early rice yields, double crop late rice yields, and single crop late rice yields per mu were all lower than the provincial average.

Chapter 5. Northern Hubei Uplands Region

The northern Hubei uplands region is located in the northern part of the province. They are connected on the north to the Nanyang Basin in Henan, on the east and south to the central Hubei hills region, and on the west to the northwestern Hubei mountain region. They extend from east to west and include Xiangyang, Zaoyang and Guanghua Counties plus Xiangfan City. Totaling 11,777,500 mu in area, or about 4.19 percent of the province's total land area, they are the smallest of the province's seven agricultural areas.

Table 5-1 Basic Data About Northern Hubei Uplands Region (1978)

Units: 10,000 mu; 10,000 persons

		Percent of provincial total
Total area	1,177.75	4.19
Cultivated land--Total	428.73	7.59
Wetlands	171.90	5.85
Drylands	256.83	9.47
Total population	258.26	5.65
Agricultural population	220.12	5.64
Average amount of cultivated land per capita of agricultural production (mu)	1.95	

In this region, each member of the labor force farms an average of 4.89 mu, more than 1 mu more than the average for the province as a whole. Since the amount of land is large relative to the labor force, it is one of the regions of the province in which soil resources are plentiful and the potential for production fairly great.

First Section. General Discussion

1. Uplands Topography and Soil Resources

Most of the northern Hubei uplands are located along the southern fringes of the Nanyang Basin where hills, uplands, mountains and riverlands may be found, uplands and hill topography predominating. The broad region to the north of the Gun He and south of the Han Shui is a vast upland known as the "three northern uplands."[1] Structurally, it is a sunken region between the Qinling folded region and the Huaiyang shield. It is part of the alluvial plain of the middle reaches of the Han Shui and the lower reaches of the Tangbai He. As a result of new structural movement, the surface of the land has been cyclically uplifted, with the result that the very thick red rock drift deposits of the Tertiary Era have been cut up by runoff water to produce the uplands topography. Meanwhile, both sides of rivers are covered by contemporary riverborne alluvium.

Since the extent to which the uplands have been cut up differs, they may be generally divided into flat hills, hills and attenuated hills. Flat hills are found mostly in the south and in places where riverlands meet. This land rolls gently and has a relative height of less than 20 meters and about 10-degree slopes. Ridges (attenuated hills) and dales (deep depressions) alternate with each other to form a plane resembling waves. This is a fairly large region and it is currently the principal cultivated area. Where water conditions permit, wetlands have been developed. Uplands occur in Guanghua and Zaoyang Counties, which are a transitional area in which hills meet. The land is pretty well cut up and quite rolling and the area is fairly small. In addition, some ridges are imbedded among the flat hills and hills, as is the case with Qifang Hill and Yaojia Hill to the north of the Gun He in Zaoyang County. Soil resources are plentiful in the three northern uplands. Today, cultivated land in this region is only about two-fifths the total land area, and roughly 1 million mu of land awaits reclamation for agriculture. Since the uplands undulate gently and are less than 100 meters above sea level, they can be fairly easily opened to agriculture to help development of farming and animal husbandry. Nevertheless, the topography limits the extent of development of the uplands. The shallow trough-like dales, the poor convergence of waters, and the spread out and isolated dammed ponds make the area prone to flood disasters and definite harm to agriculture.

Riverlands are found mostly on the shores of the Han Shui and its tributaries where the terrain is broad and flat. Cotton fields are concentrated in this area.

1. The three northern uplands include the northern uplands if Xiangyang, Guanghua and Zaoyang Counties. These uplands are also termed the northern Hubei uplands or the Xiangbei uplands.

2. Photosynthesis Potential and Moisture Conditions

This region gets plenty of sunshine, averaging between 1,900 and 2,200 hours each year, making it the area of the province that gets the most sunshine. On the basis of average values for many years, if all the photosynthesis potential could be fully used, grain yields would amount to 5,500 jin per mu. At the present time, maximum yields average 2,000 jin, the equivalent of only one-third the photosynthesis potential. In terms of photosynthesis, potential for increased grain yields from this area is very great (see Table 5-2).

Table 5-2 North Hubei Uplands Photosynthesis Potential Table

Units: Jin/mu

	Zaoyang	Guanghua	Xiangyang
January	794	756	586
February	893	837	801
March	1,110	1,097	1,050
April	1,280	1,214	1,228
May	1,577	1,462	1,479
June	1,838	1,671	1,708
July	1,833	1,676	1,712
August	1,752	1,589	1,641
September	1,250	1,090	1,125
October	1,115	999	1,010
November	799	767	809
December	739	705	686
Annual total	14,906	13,871	13,822

This region contains the Nanxiang pass, the province's only lowlying pass to the north. Cold air frequently flows southward through this pass, making it the coldest spot in the province in winter. It is also the place in the province with the greatest variation in temperatures. It is a transitional area between south and north. In spring, when cold and warm air currents frequently alternate, temperatures frequently plummet when cold air invades, causing frost and freezes at times. In autumn, cold weather comes early, with autumn winds and low temperatures usually occurring in mid-September in most years. The total frost-free period for the year is only 230-240 days. For this reason, the region does not lend itself to large area growing of two rice crops.

This is the region of the province that gets relatively little precipitation, the amount averaging less than 900 millimeters annually. Furthermore, variation from year to year is great. Little precipitation falls in winter (only 6-8 percent). The lay of the land also limits water storage, thus the region frequently faces threat from drought. This is an important element preventing full use of the huge photosynthesis potential.

3. Thick Layer of Yellow Soil That Is Clayey and Dense in Uplands

The soils of the northern Hubei uplands are complex and of numerous kinds, differing with changes in the terrain. Uplands yellow soil is most widespread. Though uplands yellow soil was formed from clay mother material in the Quarternary Period, because of differences in the degree of maturation and level of fertility, it may be divided into dead yellow soil, gray yellow soil, oily yellow soil, and jiangshi [1203 4258] yellow soil. All yellow soils, with the exception of oily yellow soil, have a thin cultivated layer, are clayey and infertile. Surveys show the cultivated layer of upland yellow soils to be between 12 and 15 centimeters, and the physical grain content of the top layer of soil (soil particles smaller than 0.01 millimeters) to be more than 50 percent. In soil substrata, such particles may range from 60 to 70 percent. As a result of long cultivation and leaching by rain, a particularly clayey and dense plow pan layer has formed at between 20 and 40 centimeters down. Soil fertility is low, nitrate and phosphate nutrients lacking. Upland soils have a thin cultivatable layer, and all layers are very clayey. Capillarity in the upper stratum of the clay is well developed, and moisture evaporates quickly. In summer loss of moisture averages between 1 and 2 percent daily; it holds moisture poorly. The lower layers show poor porosity. This makes for poor drainage of water, a large runoff coefficient, and much erosion. In addition, the soil's structure is poor and not well suited to cultivation.

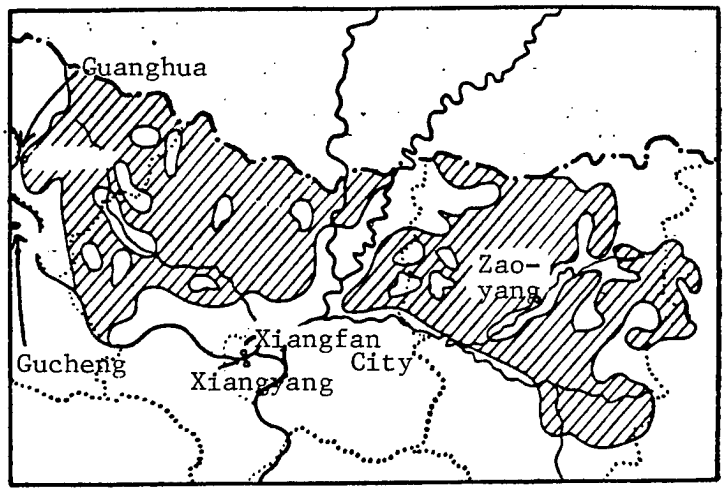

Figure 17. Map Showing Distribution of Yellow Soil in Northern Hubei Uplands

Despite these drawbacks, the layer of upland yellow soil is thick, suiting it to deep plowing. It is highly granular and highly absorbent, and benefits from fertilization endure for a long time. Through a combination of deeper plowing of the cultivated layer, increased fertilization with organic fertilizer, rational planning of crop patterns, and allowing the soil to lie fallow for a time to nurture it, the potential for high yields can be very great.

4. Give Priority to Dryland Crops, Paddy Rice Developing Rather Rapidly

The northern Hubei upland region is the area in our province where dryland is concentrated. Wheat, cotton and sesame have consistently occupied a rather large proportion of the main crop production. In 1949, the dryland of this region occupied 83 percent of the total cultivated area; that of Xiangyang occupied 89 percent; Zaoyang 72 percent; Xiangfan City and Guanghua County were almost entirely dryland. After liberation, in the wake of continuous improvement in water conservancy conditions, the wetland area was further enlarged. Following the liberation period, the 780,000 mu in 1978 increased to 1,719,000 mu, an increase of 939,000 mu (see Table 5-3); however, the dryland area remained at 60 percent.

Table 5-3 Table Showing Changes in Wetlands of Northern Hubei Uplands

Units: 10,000 mu

Year / Area / Place	1949		1965		1978	
	Wetlands area	Percent of cultivated land	Wetlands area	Percent of cultivated land	Wetlands area	Percent of cultivated land
Total for region	78.00	17.3%	123.31	25%	171.90	40%
Xiangyang	24.13	11%	48.22	21%	67.36	34%
Zaoyang	53.34	28%	67.36	34%	83.19	48%
Guanghua	0.42	0.5%	7.15	10%	20.32	33%
Xiangfan City	0.11	0.1%	0.58	11%	1.03	32%

This region has the climatic advantages of both the north and the south for the growing of early grain, sesame and cotton. In recent years, Xiangfan City's average wheat yields per unit of area have been highest in the province. In 1978, it grew 11,900 mu of wheat from which yields averaged 804 jin per mu. Xiangyang County sows a larger area to wheat than any other county in the province. In 1978, it grew 10,696,000 mu of wheat, yields averaging 292 jin per mu. This was 21 jin per mu higher than the average for the province as a whole. Xiangyang County's sesame is nationally famous. It is grown over a wide area; output is high; yields per mu are high, and output is highest in the province. In 1978, it planted 181,700 mu, or 11 percent of the province's total, and harvested an average 114 jin per mu for a gross output of 254,000 dan, or 12 percent of the total for the province. (In 1958, the all-time high year, gross output reached 446,600 dan.) Nevertheless, Xiangyang County's average yields of paddy and cotton are lower than the average for the province as a whole.

Great potential exists for development of agricultural production in the northern Hubei uplands. Estimates made by departments concerned in Xiangyang Prefecture show that were problems with water and fertility in the three northern uplands to be solved, and were the land to be leveled and farming mechanized, tremendous increases in grain and cotton output would be possible.

Chapter 6. Northeastern Hubei Low Mountain and Hill Region

This region is located in the northern half of the low mountains and hills of eastern Hubei. Its eastern and northern portions about the Dabie range watershed and Henan and Anhui Provinces. To the south it is contiguous with the Jianghan Plain, and to the west it is adjacent to the central Hubei hill region. It includes the five counties of Hongan, Macheng, Luotian, Yingshan and Dawu.

Table 6-1 Basic Conditions in the Northeastern Hubei Low Mountain and Hill Region

Units: 10,000 mu; 10,000 persons

		Percent of provincial total
Total area	1,689	6.01
Cultivated area--Total	244.51	4.33
Wetlands	173.36	5.90
Drylands	71.15	2.62
Total population	282.06	6.20
Agricultural population	269.38	6.90
Average amount of cultivated land per capita (mu)	0.91	

This region is one of the province's old revolutionary bases and the site of the "Huangan[1] and Macheng insurrections." It is a major integral part of the Hubei-Henan and Anhui revolutionary base. After liberation, the people of this region carried forward their glorious revolutionary tradition and studied the basic experiences of Dazhai. After a long period of extreme hardships and difficult struggle, they tamed the mountains, harnessed the rivers and controlled the soil in the transformation of nature and great improvement in production conditions, giving rise to a collection of advanced models and becoming one of the high yield agricultural areas in the province.

1. Huangan is the present-day Hongan.

First Section. General Discussion

1. Plentiful Natural Resources in the Southern Foothills of the Dabie Shan

This region is located in the southern foothills of the Dabie range where the overall lay of the land is high in the north and low in the south. Going from north to south, the land gradually inclines to become high mountains, low mountains and hills. As a result of slow uplifting of the crust of the land on the southern slopes of the Dabie range, plus powerful weathering and abrading, not only is the terrain of the northern watershed fairly high, but in most regions, valleys are broad and hills wide and the terrain slopes gently.

The northern part of this region is the watershed of the Dabie range. The terrain is fairly high, averaging 800-1,200 meters above sea level. The 1,729 meter high main peak of the Dabie Shan, Tiantangzhai, rises where Yingshan and Luotian Counties met in the north. The northern mountainland area is not large, but it is rather well covered with vegetation and contains fairly abundant forestry resources. Forestry survey data from 1976 shows reserves of more than 7.8 million cubic meters of timber forests, making this the major forestry base in the eastern part of the province.

In the central and southern part of this region, the terrain gradually becomes more open, and low mountains and hills abound to form a low mountain area ranging from 300 to 500 meters above sea level and a hill region less than 200 meters above sea level. Easily weathered granitic gneiss is distributed widely throughout the Dabie range and the surface of the land has been greatly cut up as a result of weathering and abrading. It looks like a broken up gentle slope. In most areas, relatively high and perfectly round hills several tens of meters in height have formed. Erosion is fierce, and formation of drift is also marked. As a result of long accumulation of drift and alluvium, fairly numerous, but not very large, basins and river valley plains have formed among the mountains. These are commonly termed "ping" [0988]and "fan" [8858] as, for example, Qili Ping in Hongan, Sanli Fan in Luotian, Dongzhuang Fan and Xizhuang Fan in Yingshan, etc. Additionally, there are fairly large alluvial plains such as the Macheng-Songfou Jushui river valley plain, which is 10 kilometers at its widest and several tens of kilometers long, making it the regions largest river valley plain. It was formed by alluvium deposit from the Ju Shui over a long period of time following graben faulting during the Cenozoic Era. In these mountain basins and river valley plains, the soil layer is thick and the land is fertile suiting it to farming. Population is dense. This is the principal grain and cotton growing area in the region.

The potential of the soil resources in this region is very great. There is an average of 6.3 mu of land per capita of agricultural population, abundant land resources for all-around development of farming, forestry, animal husbandry, sideline occupations and a fishing industry.

This region is a semitropical area sheltered to a large extent by the Dabie Shan range. As a result, it is sheltered from the wind and faces the sun. The climate is temperate, precipitation copious and sunshine ample. In winter, the Dabie Shan range blocks influx of cold air from the north, with the result that this region's January temperatures average 2-3.6°C, which is higher than on the Jianghan Plain at the same latitude. In summer, warm moisture-laden air from the south is wafted upward by the mountains, so rainfall is more abundant than on the Jianghan Plain at the same latitude. Rainfall averages 1,100-1,400 millimeters per year here. The effect of landforms on rainfall distribution is marked, distribution decreasing gradually from east to west. Annual rainfall is concentrated between April and September during the period when crop growth is most vigorous. At this time between 900 and 1,100 millimeters falls. This region gets plenty of sunshine, averaging more than 2,000-2,200 hours annually. It gets more sunshine than any other region in the province and the photosynthesis potential here is also greatest.

The occurrence during the same season of rainfall and heat, and the copious sunshine provides excellent water and heat conditions for the growing of three wetland crops and for development of heat-loving economic forests.

The Dabie range is the watershed for the Chang Jiang and the Juai He. Except for the Zhugan He in Dawu County, which flows into the Huai He, all rivers in this region flow into the Chang Jiang. Almost all the major streams on the north shore of the Chang Jiang in eastern Hubei rise in the northern mountains of this region. The major streams are the Xi Shui, the Ba He, the Ju Shui, the Dao Shui and the Dawu He. Since the southern end of this region is close to the Chang Jiang, streams here are relatively short, averaging only about 100 kilometers in length. This region is located in the middle reaches of most streams, and because of the rise and fall of the mountain ranges, river beds are precipitous and the current cascades down them. Water power is abundant at an estimated almost 200,000 kilowatts.

The Dabie range has been greatly affected by diastrophism; fracturing has been violent, and there are many rift zones on the crust of the earth. A fairly large one is the Macheng-Tuanfeng rift zone running northeast to southwest, which poses an earthquake threat.[1] Geothermal resources and metamorphized mineral resources are fairly plentiful. Examples include the hot springs of Xitang He in Yingshan, and at Sanli Fan in Luotian, whose water

1. Records show the occurrence of earthquakes of varying degrees of intensity in each of the counties of this region. Macheng is the earthquake epicenter where historically powerful earthquakes have occurred. According to the Macheng County Annals, in February 1851 "Yuanjia Shan suddenly split apart with a thunderous sound, a crack 2 chi wide, more than 200 zhang long, and so deep the bottom was not visible, appeared. When a stone was dropped into it, a sound returned. Gradually the crack widened." In May 1863, "it split again, and though the crack closed this time, its outlines still remain." On 7 February 1913, a grade 5 earthquake occurred near the Macheng city gate. On 5 April 1932, a grade 6 earthquake occurred in the yellow earth hills to the north of Macheng.

temperatures are high and water volume great. They are famed throughout the province. Phosphate rock in the Huangmai Range in Dawu and serpentine rock at Luyinwang Shanzhai exists in large quantities. Virtually every county has small iron mines, and mica, quartz, asbestos and fluorspar are found widely. Copper, nickel, lead, magnesium, manganese, graphite and marble are also widespread, providing excellent conditions for development of commune-operated mining industries.

2. Control of Erosion and Change of the Natural Landscape

Before liberation, soil erosion in this region was serious and both flood and drought disasters frequently occurred.

The Dabie Shan is an ancient land mass that has been deeply eroded in which granitic gneiss and crystalline schist are widespread and in which the weathering of the rock formations has been severe, the weathered layer being a general 20 to 30 meters thick.[1] The mountainland soil of this region has been formed largely atop the weathered layer of the foregoing loose granitic gneiss as sandy soil (popularly known as magu soil). The major components of magu soil are quartz and mica. It is very granular and contains little organic matter. Its granular structure is poor. Every 100 grams of magu soil is 60 percent fine sand and small stones, which is severely scoured with each heavy rainfall, the soil running off with the water, causing serious erosion and causing a seriously eroded area. The erosion modulus is about 1,000 tons per square kilometer.

In this region, rainfall is concentrated from April to September when about 75 percent of the annual amount falls. The rains are frequently torrential, making this the region with the most torrential rainy days in the province, and one of the torrential rain centers in which torrential rains are severe (see Table 6-2). Numerous torrential rains during summer frequently give rise to mountain torrents in which flood waters carrying gravel cascade down mountain slopes, both intensifying soil erosion and frequently causing flood disasters. It rains but little in autumn, making the area prone to drought and causing hardships for agricultural production.

Table 6-2 Average Number of Days of Torrential Rains Per Year in Hubei Province's Northeastern Counties (1959-1975)

Units: Days

	Hongan	Macheng	Luotian	Yingshan	Dawu
More than 50 millimeters of rainfall per day	50	47	62	63	71
More than 100 millimeters of rainfall per day	12	8	11	15	12

1. When the river bed at Liziao in Luotian was changed and the foundation for a dam cleared, a 42-meter thick weathered layer was found.

Except for some precipitousness in the upper reaches of streams in this area, in middle and lower reaches water courses meander as a result of the gently sloping lay of the land. Thus river beds undulate left and right, flow at slow speed and gradually the silt they contain precipitates out to form numerous sand spits, bars and C-shaped or S-shaped curves. In Macheng County alone, over a course of only 119 kilometers, the Ju Shui has eight such sharp turns. In the course of only 97 kilometers within Hongan County the Daoshui has 14 sharp curves. The greater the amount of precipitation, the more extreme the changes in the rivers, and streams tend to become torrential. During the rainless period, the streams trickle, the water being only 2 to 3 centimeters deep, and the volume of flow being only 1/10th of a cubic meter per second or possibly stopping entirely making it difficult to use water for irrigation. But right after a torrential rain, the flood waters converge, the rivers suddenly rise by from several to more than 10 meters and maximum volume may reach 2,000, 3,000, or even more than 4,000 cubic meters per second frequently causing flood disasters. A case in point occurred on the Dong He in the upper reaches of the Xi Shui. On 6 June 1969, the river's volume was only 0.142 cubic meters per second, but when a mountain torrent was unleashed on 14 July of the same year, volume reached 4,250 cubic meters per second, a difference of almost 30,000 times! During the over 440 year period between 1473 and the eve of liberation, 20 fairly major flood disasters occurred with a frequency of once almost every 20 years; ordinary floods occurred once every 5 years. In many years, floods alternated with droughts.

For many years the people of northeastern Hubei, which has a rich revolutionary tradition, have controlled erosion and changed the conditions of agricultural production. Using a spirit of the "foolish old man who moved the mountain," they have tackled in a comprehensive way and on a large scale problems pertaining to mountains, waters, fields, forests, electric power, roads and villages, scoring great achievements. As of the end of 1978 they had built seven large reservoirs including those on the Fuqiao He, in Ming Shan, on Jinsha He and at Zhangjiazui, 806 medium and small reservoirs, plus 280,000 dammed ponds and several thousand intersecting irrigation canals across the landscape to form a water conservancy network combining the large, the medium and the small. The reservoirs had a storage capacity totaling 2.457 billion cubic meters for the irrigation of a 1,956,000 mu area or 80 percent of the total cultivated land area, providing a powerful defense against both flood and drought disasters. They completed terracing of 348,500 mu of slopes and planted 4,518,000 mu of soil conservation forests, which have played a very great role in controlling erosion. Throughout the region, hydroelectric power stations with an installed capacity of 50,352 kilowatts have been built at 416 sites, making this one of the areas in the province in which small hydroelectric power has been most extensively developed. Since Yingshan County began the large scale, all-around tackling of problems in 1970, it has scored very great accomplishments in harnessing waters, improving the soil and running hydropower stations. Agricultural production conditions have improved markedly; agricultural production has risen rapidly; the collective economy has been steadily consolidated; and the entire region has played a leading role.

3. Grain Production Rapidly Increasing; All-Around Development of the Diversified Economy

At present, northeast Hubei is one of the areas of the province where the growing of grain, cotton and oil-bearing crops and the all-around development of the diversified economy is rather good and the production level is rather high. The region's multiple cropping index averages 211.7 percent, which is higher than the average for the province as a whole.

This region has a large population relative to farmland, with cultivated land averaging 0.91 mu per capita. Wetlands account for 71 percent of the total cultivated land area, and rice output accounts for more than 80 percent of total grain output. Except for a small number of mountain regions, two crops of rice are grown virtually everywhere, and a three crop system is also developing fairly rapidly. In 1978, the region's grain output totaled 2.1 billion jin, one and one-half times more than in 1949. For the region's five counties, since 1969 grain yields have been greater than 800 jin per mu and in 1978, grain yields averaged 995 jin per mu. Yields for Hongan, Dawu and Yingshan were larger than 1,000 jin per mu.

This region is the major peanut producing area of the province. Hongan, Macheng and Dawu Counties have an annual output of more than 100,000 dan. During the all-time high record year of 1977, peanut output for the three counties totaled 586,000 dan, or 43 percent of the total for the province as a whole. As compared with 1949, this was a fourfold increase for Hongan County, a fivefold increase for Macheng County and a more than fivefold increase for Dawu County.

In recent years, the region's cotton field area has stabilized around 210,000 mu, or approximately 30 percent of the total dryland area. Despite serious drought in 1978, cotton output was 167,000 dan, and yields were 80 jin per mu. During the record year of 1974, cotton output was 260,600 dan, and yields were 117 jin per mu. Most of this region's cotton fields are found on river valley plains where natural conditions are rather good and water conservancy and irrigation convenient. Such plains account for half the cotton field area in the region, as for example in the basin and river valley areas among the mountains in places such as Chengguan, Zhongyi, Songfou, Tiemen and Baiguo on both banks of the Jushui He in Macheng County.

This region is one of the province's major bases for economic diversification. State procurement of local specialties in 1975 was 62 percent greater than in 1965. In 1975, output of mulberry silkworm cocoons was 2.5 times higher than 1965; green tea increased 2.8 fold; rape seeds increased almost two times; and tung oil seed output nearly doubled (see Table 6-3).

To summarize the foregoing, since liberation this region has undertaken all-around control. In the transfiguration of mountain regions and adherence to "taking grain as the key link in a program of all-around development," it has achieved marked achievements. However, when judged in terms of needs for the building of socialist large-scale agriculture, numerous problems remain. Today the erosion area continues to be substantial and efforts to bring

Table 6-3 Position in the Province of Major Specialties From Hubei's Northeastern Region (1978)

Units: Dan

Name of product	Output	Percent of province's output	Producing counties
Mulberry silkworm cocoons	40,562	56.0	Luotian, Macheng
Chinese chestnuts	53,360	58.0	Luotian, Macheng
Medicinal herbs	31,004	12.2	Yingshan, Luotian
Including: Fuqin [0126 5355]	18,748	80.0	Yingshan, Luotian
Chinese tallow seeds	175,606	34.0	Luotian, Yingshan, Macheng, Dawu
Rapeseeds	22,365	10.0	Macheng, Luotian
Tung oil seeds	68,625	10.0	Luotian, Macheng, Yingshan
Green tea	35,951	10.2	Yingshan, Hongan
Flue-cured tobacco	150,835	12.0	Hongan, Dawu
Moso bamboo	1,232,271	12.1	Luotian, Yingshan

problems under control in a comprehensive way are not sufficiently balanced. In some places, control standards are too high and capabilities to withstand major flood or drought disasters still not very strong. The task of bringing farmlands under control in farmland capital construction is a fairly arduous one. In agricultural production, as a result of the small amount of farmland relative to population, grain output per capita of agricultural population remains lower than the provincial average; production of oil-bearing crops is inconsistent and has not returned to the all-time high level; development of economic diversification is uneven and outputs are inconsistent. Output of some traditional products is even less than before liberation. In the future, this region will have to continue to tackle vigorously its problems of mountains, water, fields, forests and roads in a comprehensive way, do a good job of soil and water conservation, further change agricultural production conditions, continue to raise output levels for grain, cotton and oil-bearing crops, and increase the grain commodity rate. It will have to build bases for economic diversification, and bring about substantial development of both grain and economic diversification within a short period of time.

Chapter 7. Southeastern Hubei Low Mountain and Hill Region

The southeastern Hubei low mountain and hill region is located in the southeastern part of the province. To the southwest, it abuts Hunan; in the southeast, it neighbors Jiangxi; in the northeast it touches the south bank of the Chang Jiang, and in the northwest, it is contiguous with the Jianghan Plain. It includes Xianning, Puche, Tongche, Chongyang, Tongshan and Yangxin Counties, as well as Huangshi City (including Daye). Cultivated land averages only 1.19 mu per capita, which is lower than the average 1.45 mu for the province as a whole. It is an agricultural area in which population is large relative to land.

Table 7-1 Basic Facts About the Southeastern Hubei Low Mountain and Hill Region (1987)

Units: 10,000 mu; 10,000 people

		Total for southeastern Hubei low mountain and hill region	Percent of provincial total
Total area		2,143.05	7.62
Cultivated land:	Total	329.00	5.82
	Wetlands	227.20	7.73
	Drylands	101.80	3.75
Total population		335.49	7.33
Total agricultural population		277.49	7.10
Average amount of cultivated land per capita of agricultural population		1.19	

First Section. General Discussion

1. Much Mountainland and Plentiful Water Energy

This region is located on the north side of the Mufu Shan where the topography slopes from the south toward the north and may be roughly divided into southern and northern parts. The southern part includes Tongcheng County and parts of Chongyang, Tongshan and Yangxin Counties. The land is made up of granite that has been severely cut up into mostly medium and low mountains and hills. Elevation above sea level runs from 500 to 800 meters and Mufu Shan on the southern fringe of the area averages an elevation of about 1,000 meters. As a result of the hot and moist climate, the outcropping granitic rock has been weathered and eroded to make the mountain tops round and the slopes steep. Ravines and valleys cut between mountains and the topography is pretty well cut up. Soil erosion is serious here, the amount of erosion averaging about 500 tons per square kilometer. Erosion in Tongcheng and Chongyang Counties presently occurs over a more than 400 square kilometer area. The northern part of the region is a transitional zone between the Mufu Shan and the Jianghan Plain that includes Puche, Xianning and Daye Counties, plus parts of Chongyang, Tongshan and Yangxin Counties. Elevation above sea level is between 200 and 500 meters. Here the topography is overwhelmingly hills and the surface of the land is composed of not only sandstone and slate, but of limestone as well. Karsting is fairly severe, and dissolution lowlands, corroded caves, sinkholes and such karst topography are common.

Structural influences have given rise to a series of vertical and horizontal dislocations. Subsequent abrading by streams over a long period of time has formed a distinct alternating mountains and valleys running parallel to each other, and basins among the mountains and hills. These have controlled development of the water system, most streams extending along the vertically and horizontally dislocated broken up zone to form a checkerboard-like water system. The Fu Shui and the Lu Shui are the two most important streams in this region that have formed the two water systems that crisscross this region. The Fu Shui rises in the northern foothills of the Jiugong Shan of the Mufu range in the border between Hubei and Jiangxi and cuts across Tongshan and Yangxin Counties from southwest to northeast. It passes through Wang Hu and enters the Chang Jiang at Fuchikou, traveling a distance of 180 kilometers. Wang Hu in its lower reaches is a schistosomiasis area where comprehensive control projects are currently underway.

The Lu Shui rises near the main peak of the Mufu Shan and flows from south to north across Tongcheng, Chongyang and Puche veering northwestward and entering the Chang Jiang at Luqikou, traversing a distance of 180 kilometers and having a 3,950 square kilometer basin area. Construction of the Lu Shui Reservoir, which was begun in 1958, played an important role in transfiguring this region.

In addition to the Fu Shui and the Lu Shui, this region has countless other tributaries and small streams throughout its numerous mountains and deep valleys. These provide not only resources to help irrigation and water transportation, but also hold plentiful water energy resources. The water energy contained in this region has been estimated at more than 400,000 kilowatts. Since liberation, and particularly during the past few years, water energy resources in this region have undergone rapid development with the construction of small hydroelectric power stations at 400 sites, with an installed capacity of 113,000 kilowatts. Another huge potential remains. The three large rivers, the Fu Shui, Lu Shui and Quan He, for example, had an installed capacity of only 97,000 kilowatts in 1977, or only 24 percent of water energy reserves.

2. Much Precipitation and Ample Heat

The climate in this region is mild in winter and hot in summer. Much precipitation falls during winter and spring. The rainy season begins early and precipitation is fairly evenly distributed.

Inasmuch as the Mufu range runs from northeast to southwest, it faces the direction of the warm, moist flow of air during summer. This plus the forcibly uplifted terrain makes this region one that gets most rainfall in the province. Volume of precipitation diminishes with the topography from south to north. Annual precipitation amounts to 1,300-1,600 millimeters, and in the vicinity of the Jiugong Shan it may be more than 2,000 millimeters. Between 35 and 40 percent of all precipitation falls in the spring; between 35 and 39 percent in summer; between 14 and 16 percent in autumn; and between 12 and 14 percent in winter. As spring faces into summer, the southeast monsoon winds arrive, and cyclones from south of the Chang Jiang frequently cross into the region. Numerous fronts occur and remain static over the area. Much precipitation then falls within a concentrated period of time, reaching more than 600 millimeters between April and June. Though this favors transplanting of the early rice crop, the early growth of spring tea, and the floating of timber on streams, the excessive moisture and paucity of sunshine is unfavorable for the flowering, coming into milk and harvesting of crops that are harvested in summer. This region is also one of the province's centers of torrential downpours, which may occur during any month of the year, but mostly come between May and August (see Table 7-2), readily causing flood and waterlogging disasters. After the second month of summer, the front shifts northward, and precipitation decreases and then summer and autumn drought frequently occurs. Though precipitation during winter is only one-third that of spring, nevertheless this is the region of the province that gets the most winter rainfall.

Temperatures in this region are relatively high. During January, the temperature averages around 4°C, second only to the southwestern Hubei low mountain and river valley region. Except for the three counties in southern Hubei, during July temperatures average more than 29°C, making this a part of the province's hot summer area. Between 235 and 240 days of the year have daily temperatures averaging more than 10°C and cumulative temperature is between 5,200 and 5,400°C. For between 185 and 190 days temperatures continue at more

than 10°C to more than 20°C, during which cumulative temperatures range from 4,300 to 4,600°C. The frost-free period is 250-270 days, which is more than on the Jianghan Plain at the same latitude, and similar to areas along the Chang Jiang in the east.

Table 7-2 Average Number of Days of Torrential Rainfall Each Year in the Southeastern Hubei Low Mountain and Hill Region (1959-1973)

Units: Days

	Number of days having more than 50 millimeters of rainfall		Number of days having more than 100 millimeters of rainfall	
	Between May-August	Per Year	Between May-August	Per Year
Huangshi	63	74	8	9
Puche	68	86	10	12
Chongyang	62	85	13	14
Tongcheng	61	75	11	12
Tongshan	56	68	8	9
Yangxin	57	74	10	11
Xianning	61	83	12	13

The warm moist climate provides abundant water and heat resources for this region's development of grain production and economic diversification.

3. Mostly Red and Yellow Soils of High Acidity

Most of the soil in this region is either red or yellow soil. Red and yellow soils form in climates that are very warm and have a lot of precipitation. Because chemical weathering of rock is strong, minerals are completely dissolved from it and the decomposed salts washed away. The relatively large amounts of weathered, stable oxides of iron and aluminum concentrates remaining, as well as the not readily weathered quartz, imparts a markedly red color to the soil. Where a large volume of water exists in combination with oxidized iron, the soil's color changes in varying degrees from red to yellow. As a result of the strong leaching action, usually the surface layer of the soil is fairly clayey, is deficient in organic matter, and has a pH of 5.5-6.0, exhibiting an acidic or strongly acidic reaction.

The wetlands soil of the southeastern Hubei is red and yellow soil for the most part. Most of it is found along river valleys or in places where the terrain is lowlying. Since water conditions are fairly good and cultivation fairly intensive, the soil layer is thick. Thanks to steady improvement, the fertility of most of this soil has markedly increased today. However, in mountain valleys or in shaded glens and places having cold spring water, because of the low soil temperature, mostly the fields are cold and waterlogged

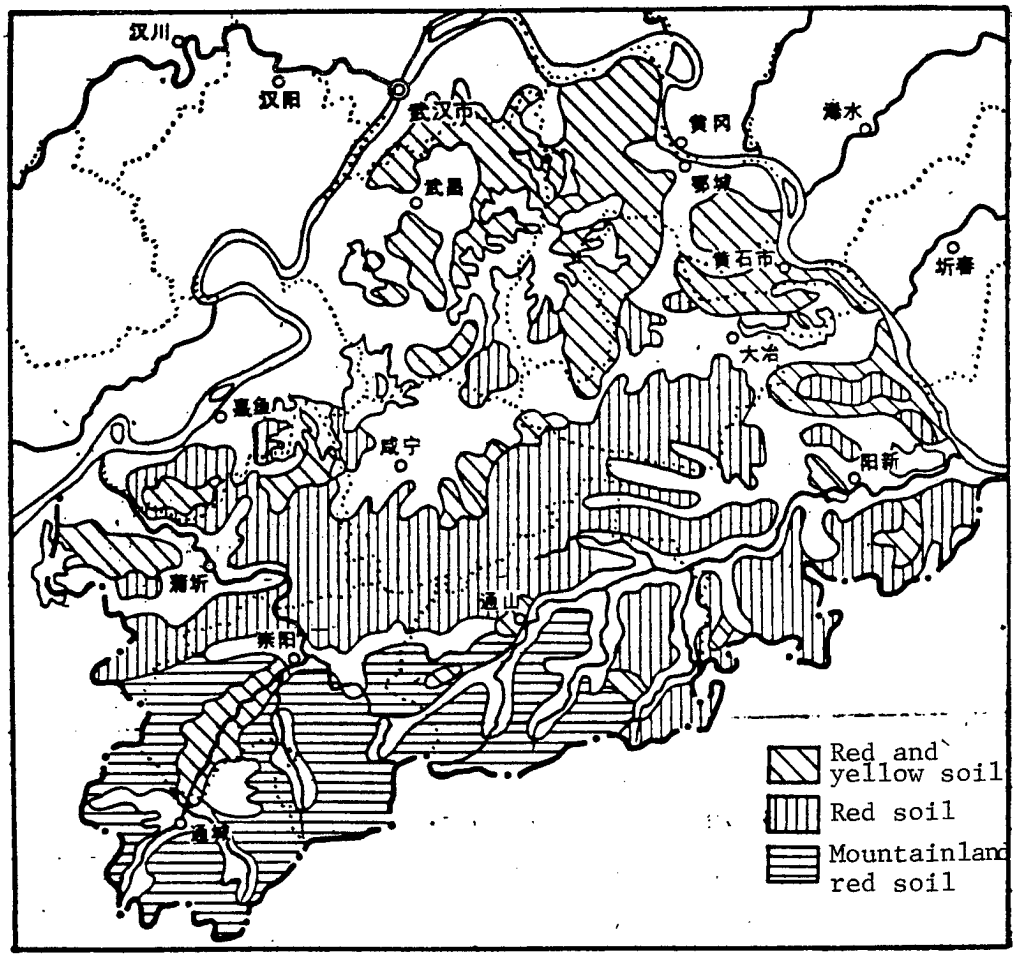

Figure 19. Map Showing Distribution of Red and Yellow Soil in Southeastern Hubei

or muddy. This is one of the main reasons for low paddy yields. Drylands are mostly red and yellow soils that are found atop low mountains and hills and at the upper parts of slopes. Such soils are not very mature; the cultivated layer is shallow; they tend to be clayey; soil fertility is not high, and they can withstand neither drought nor waterlogging. These soils are major low yield soils in the area.

4. Fairly Good Basis for Growing Bamboo, China Fir, Tea and Ramie

This region has superior conditions for the growing of bamboo, China fir, tea and ramie. These crops are grown in a concentrated area where conditions for their production are fairly good and they have a very important position in the province as a whole (see Table 7-3). Take 1975, for example, when 3.5 million stalks of moso bamboo was transported from the region. Dark green tea shipments totaled 134,000 dan for third place in the country. Ramie sales to the state totaled 53,304 dan, which was 63 percent of the province's total ramie sales to the state. An additional 16,472 dan of ramie was exported, accounting for 75 percent of the province's total ramie exports.

Table 7-3 Status of Moso Bamboo, China Fir, Tea and Ramie Production in Southeastern Hubei in 1977

	楠竹 (a)		杉木 (b)		茶叶 (c)		苎麻 (d)	
	面积(e) (万亩)	采伐量(f) (万根)	面积(g) (万亩)	蓄积量(h) (万方)	面积(g) (万亩)	产量(i) (担)	面积(e) (万亩)	产量(i) (担)
(j) 全省	109.11	938.35	460.49	528.67	125.86	352,330	15.71	123,338
(k) 鄂东南区	77.80	668.52	72.07	74.71	26.10	176,725	9.93	75,118
(l) 占全省%	71.30	71.24	15.65	14.13	20.73	50.16	63.21	60.90

Key:
a. Moso bamboo
b. China fir
c. Tea
d. Ramie
e. Area (10,000 mu)
f. Amount cut (10,000 stalks)
g. Area (10,000 mu)
h. Reserves (10,000 cubic meters)
i. Output (dan)
j. Province as a whole
k. Southeast Hunan
l. Percentage of province total

Moso bamboo is found mostly midway up mountains at 500-800 meters and grows mostly in Tongshan, Chongyang, Puche and Xianning Counties. Tongshan County holds first place both in moso bamboo growing area and quantity of reserves, accounting for 30 percent of the province's moso bamboo growing area and 23 percent of its reserves. China fir is found mostly above 600 meters in the northern foothills of the Mufu range, which is fabled as a "pine and fir hat." Tongshan and Chongyang Counties are the areas in this region in which China fir forests are concentrated, covering 52 percent of the area. Reserves are even larger. Tea grows mostly in low mountain and hill regions at 300-500 meters above sea level. At the present time, except for Yangxin and Daye Counties where output is fairly low, five other ones are all major tea producing counties. The tea plantation area of Puche and Xianning Counties is fairly large, accounting for about 50 percent of the tea plantation area of southeastern Hubei. Ramie is grown on low hills and gently slopes between 200 meters and is concentrated in southeastern Hubei and areas adjacent to the Jianghan Plain. Today, ramie is grown mostly in Daye and Yangxin Counties where both the ramie growing area and output amount to about 70 percent of the total for southeastern Hubei. Puche and Xianning Counties rank second. Tea oil is produced mostly in mountain regions below 400 meters in Tongshan and Tongcheng Counties. There are also scattered plantings on low mountains in other counties at between 400 and 800 meters above sea level.

5. Fairly Great Potential for Increased Paddy Output

Major accomplishments in the capital construction of farmland have taken place in this region since liberation. Large, medium and small reservoirs have been built at 639 sites and newly built electromechanical irrigation and drainage stations have an installed capacity of 291,000 horsepower. A total of 4.491

billion cubic meters of water have been brought under control including the impounding, diversion, or lifting of an effective volume of 2.377 billion cubic meters. The effectively irrigated area is 2,415,700 mu, or 73.4 percent of the cultivated land. This includes an area of 1,862,700 mu, or 56.6 percent of the cultivated land area, from which a harvest may be assured despite drought or waterlogging. A harvest may be assured despite drought or waterlogging from more than three-fourths of wetlands.

As water conservancy conditions have improved, the proportion of wetlands in this region have steadily grown to the point where the region has the highest proportion of wetlands in the province. In 1978, the region's wetland area covered 2,272,000 mu, or 69 percent of all cultivated land. Except for Tongshan and Yangxin Counties in which the proportion of wetlands decreased as a result of the inundation of some wetlands in order to build a reservoir, the wetland area in other counties accounts for more than 70 percent of the cultivated land. In Tongcheng County, wetlands account for 88 percent of the cultivated land making it the county with the highest proportion of wetlands in the region, and in the province as well.

Because of the high proportion of wetlands, paddy rice holds a decisive position in overall grain output (see Table 7-4). In 1978, 71 percent of the total area sown was sown to paddy rice and 75 percent of wetlands were a double rice crop area, which was higher than the provincial average. Paddy rice accounts for 83.04 percent of total annual grain output. Except for Tongshan County where paddy rice accounts for 60 percent of all grain output, in all other counties the average is more than 80 percent, including Puche County where it is more than 90 percent.

Table 7-4 Status of Paddy Rice Production in Southeastern Hubei in 1977

Units: 10,000 mu; 10,000 jin

	Southeast Hubei	Whole province
Grain crops for the whole year		
Area sown	556.00	8,484.56
Total output	220,582	3,233,039
Paddy rice		
Area sown	396.23	4,630.36
Percentage of total area sown to grain	71.26	54.57
Output	176,420	2,421,855
Percentage of total area sown to grain	77.54	74.91
Double cropped rice		
Area sown	170.63	1,821.52
Percentage of wetlands	75.07	61.22

Chapter 8. Southwestern Hubei Mountain Region

The southwestern Hubei mountain region is located in the southwestern part of the province. It connects with the northern Hubei mountain region on the north and with the Jianghan Plain to the east. To the west, it borders Sichuan and to the south it neighbors Hunan. It includes Enshi, Jianshi, Badong, Lichuan, Xuanen, Xianfeng, Laifeng and Efeng Counties plus the Laifeng Tu Nationality Autonomous County in Enshi Prefecture and Yichang, Yidu, Yuanan, Xingshan, Zigui, Changyang, Wufeng County and Yichang City in Yichang Prefecture, a total of 15 counties and cities. This region is populated not only with members of the Han nationality, but also with Miao, Zhuang, Tai, Bai and Tu fraternal nationalities.

Table 8-1 Basic Facts About the Southwestern Hubei Mountain Region (1978)

Units: 10,000 mu; 10,000 people

		Southwestern Hubei Mountain Region	Percentage of province as a whole
Total area		6,655.75	23.68
Cultivated land:	Total	759.96	13.45
	Wetlands	196.25	6.68
	Drylands	563.71	20.78
Total population		567.29	12.40
Agricultural population		507.26	12.99
Average amount of cultivated land per capita of agricultural population (mu)		1.5	

First Section. General Discussion

1. Towering Mountain Plateau Topography

The southwestern Hubei mountain region is an extension of the Yunnan-Guizhou Plateau and is formed from a series of mountain ranges that run from northeast to southwest, including the Yue Shan (also known as Chengqiyue Shan), Wuling Shan, Wu Shan and the Daba Shan ranges. Except for the low flat terrain along the Chang Jiang below Nanjin Pass at Yichang on the eastern edge of the area, the region's topography is a myriad of towering mountain ranges that is commonly termed a "mountain plateau." The land averages an elevation of more than 1,000 meters above sea level and many mountain peaks are over 1,500 meters high. One such is the Xiaoshennongjia at a point of intersection in the northwestern Hubei mountain region, which is 3,005 meters high. However, the top of the plateau as a whole is a vast expanse on which there are limestone hills that rise and fall in endless procession, giving rise to the name "hill plateau." The mountainlands where Hubei borders on Sichuan and Hunan Provinces have sharp spines and fall precipitously. Though the slopes of most other mountains are extremely steep, their tops are fairly flat, and among the mountains lie basins or flat tracts. The Chang Jiang cuts through the Wu Shan to form the famed three gorges, which is a unique geographic unit in which the gorges may be as wide as 250-350 meters or as narrow as 150 meters. The gorges average 400-600 meters in depth to form a wall of precipices along the Chang Jiang. Odd-shaped peaks stick upward, and through the valley the current surges. Water energy resources are extremely plentiful.

This region's usefulness for agriculture is usually divided into three types in terms of varying elevation above sea level. One is the high mountains at more than 1,200 meters above sea level. Two is secondary high mountains at an elevation from 800-1,200 meters above sea level. Three is low mountains at an elevation of less than 800 meters above sea level. Among all three types, conditions for agricultural production are best in the low mountains. But this is not a large area. The area of the high mountains is considerable, but temperatures there are fairly low. Secondary high mountains cover a vast area too, and both climate and soil in them is fairly well suited to development of agricultural production. They hold greatest potential.

Limestone is widespread throughout this region. It has been cut deeply into canyons and corroded and dissolved to form lowlands and caves. Underground streams and box canyons can be found everywhere. The "hungry dragon swallowing a river"[1] in the upper reaches of the Qing Jiang, the Niuganmafei Gorge among the three gorges of the Chang Jiang, Bingshubaojian Gorge and Shennu Peak are all marvelous sights resulting from karsting. In addition, quite a few place names such as Heaven's Bridge in Enshi, Falling Water Cave in

1. The Qing Jiang flows into the scenic Falling Water Cave to become an underground stream 7 kilometers north of Guangdong in the Lichuan Basin. After flowing underground for about 8 kilometers, it reappears above ground at Heidong in Zhusha Commune, and is called the "hungry dragon swallowing a river."

Lichuan, Mortise Cave in Lafeng and Golden Cave in Xianfeng are picturesque descriptions that the local masses have applied to the karst topography. Development of karst topography in this region has brought definite difficulties for development of farmland irrigation as well as for the impounding of water in some parts of this region. However, rainfall is copious in this region and ground water resources are copious. All that is required is further development of water resources plus full use of them, then these difficulties can be solved fairly readily.

2. The Vertically Changing Climate

This region has a temperate and moist climate with temperatures averaging around 16°C. Annual precipitation reaches about 1,400 millimeters. Water and heat conditions are extremely good. However, the region's topography is complex, and differences in elevation great, so there are marked vertical differences in climate from one place to another (see Table 8-2). A survey of the agricultural climate conducted in all jurisdictions shows that with each 100 meter rise in elevation above sea level, average temperature drops 0.6°C.

Table 8-2 Comparative Temperatures at Different Elevations in the Southwestern Hubei Mountain Region

Units: °C

Elevation area	Highest mountains	Second highest mountains	Low mountains
Representative station	Lucongbo	Lichuan	Enshi
Measuring station elevation (meters)	1,819.3	1,071.0	437.2
Average annual temperature	7.8	12.8	16.4
Average temperature during summer months	17.3	22.2	26.1
Average temperature during winter months	-2.2	2.8	6.1
Highest temperature extreme	29.0	35.4	41.2
Lowest temperature extreme	-16.1	-8.5	-5.2

Because of the protection that high mountains afford, cold air cannot invade low mountain flatlands and gorges during the winter season, making them warm regions of the province during winter. Except for January 1977, when the lowest temperatures in 80 years caused freeze damage, lowest temperatures averaged -7°C and above, providing fine overwintering conditions for semi-tropical fruit trees such as citrus fruit trees. With the descent of winter each year, high mountain areas such as Wanchaoshan, Chunmuying and Lucongbo become covered with snow and ice, but the gorges on both sides of the Chang Jiang and the Qing Jiang remain green, "the tops of high precipices being covered with white snow, while orange groves in the foothills are bright green woodlands."

The vertical difference in frost-free period is also marked from one place to another. The Chang Jiang gorges have a long frost-free period, sometimes as long as more than 290 days. At Zigui in the gorges, it reaches 308 days. On most low mountain flatlands, it is more than 260 days. In secondary mountains at places, such as Lichuan, it is 230 days. In high mountain areas, such as at Lucongbo, it is less than 210 days. In some places it is only 180-odd days. A survey shows that for each 100 meter rise in elevation, the frost-free period is between 4 and 6 days less. As elevation above sea level rises, the crop growing season shortens. In general, the crop growing season comes between 15 and 20 days later in secondary high mountains than in low mountain flatlands. It comes 30 to 40 days later in high mountain areas than in low mountain flatlands. For example, the corn sowing season at Jianshicheng Pass (614 meters above sea level) begins around the vernal equinox, while at Huaping (1,270 meters above sea level), it begins just 5 days before Qingming [around 5 April]. At Mianwuxing (elevation, 1,760 meters), it must be sown during Guyu [around 20 April]. All in all, there is a month's difference in planting time. It has been calculated that for every 100 meter rise in elevation above sea level, the time for sowing corn is delayed by about 3 days. The difference in ripening times for corn is even greater. Survey data from Jianshi County shows this to be between 20 July and 10 August in low mountain regions, between 10 and 30 September in secondary mountain regions, and around 10 October, or even as late as the end of October in high mountain areas. Except for high mountain regions where temperatures are lower, cumulative temperatures for days when temperatures are greater than 10°C are more than 4,800°C in low mountain flatlands. In the Qing Jiang river valley, they are more than 5,000°C; in the three gorges of the Chang Jiang, they are more than 5,500°C; and in Zigui in the gorges, they reach 5,690°C, making this region one of the most abundant heat resources in the province.

As elevation above sea level varies, corresponding changes also occur in the amount of precipitation from place to place. Survey data on agricultural climate from a number of counties shows that for each 300 meter rise in elevation above sea level, annual amount of rainfall increases by about 100 millimeters. In the three gorges of the Chang Jiang, rainfall is about 1,100 millimeters per year, while about 1,900 millimeters fall in Lucongbo. Most places in Jianshi County get more than 1,400 millimeters, while low mountain regions get about 1,200 millimeters. In the high mountain area around Kuangchangping in the northwest, 2,114 meters fall. Generally speaking, the amount of precipitation is plentiful in high mountains, secondary high mountains and low mountains alike, and it is mostly concentrated during the period of crop development (April-October). For example, at Kuangchangping in Jianshi County, 1,735.2 millimeters of rain falls between April and October, and even at Gaoping, where rainfall is least, 1,033.4 millimeters falls. It is noteworthy that distribution of rainfall during various development periods for crops is frequently uneven and that low temperatures and continuously rainy and overcast weather frequently occurs during spring. During summer, there are torrential rains and drought, and in autumn there are low temperatures and continuous periods of overcast and rainy weather. The summer droughts of low mountain and secondary high mountain areas, the autumn

winds and early frosts, and the rime fogs and high winds in mountain areas pose very great dangers to agricultural production. Furthermore, year to year variations in amount of rainfall exist. The ratio between years of maximum and minimum rainfall is 1:1.5-1.7, which can mean disaster for farm crops. Nevertheless, the annual variation in rainfall in this region is far less than on the Jianghan Plain and in other regions. In 8 or 9 years out of 10, this region gets more than 1,200 millimeters of rainfall and the certainty of precipitation is greater than for other areas. This helps agricultural production.

3. Plentiful and Varied Natural Resources

This is a vast area with temperate climate, copious rainfall, fairly good soil and extremely plentiful resources for farming and forestry. The region now has 7,599,600 mu of cultivated land, or an average of 1.5 mu per capita of agricultural population, which is higher than in mountain areas elsewhere in the province. Incomplete statistics show that in terms of properties and fertility, 76.3 percent of the cultivated land has good or fairly good soil, and only 23.7 percent of the soil is poor. The purple-red soil (pig liver soil) of the low mountain and hill region, the main soil of secondary high mountains and the yellow soil, yellow gravel soil, and bluish gravel soil of mountainlands, as well as the gray soil of high mountains could all be good soils. All they need is sensible use and improvement, and they would show very great potential for increased yields. This region has a 15.73 million mu area of mature forests. The forest cover rate is 25.04 percent, and timber reserves on the stump are 28.67 million cubic meters for first place in the province. More than 11 million mu of barren mountains and wastelands suitable for forests have yet to be put to use. This is the largest such area in the province. Plant resources are even more plentiful and varied. From the low mountain river valleys to the high mountain ranges grow all kinds of semitropical, warm temperate zone and cold temperate zone plants of between 1,000 and 2,000 varieties. There are more than 40 varieties of forest trees of which the metasequoia of Lichuan Creek are rare remnants from ancient times. Most of the forests are of China fir, massoon pine, cypress, oak, bamboo, camphor, Phoebe nanmu, birch and white poplar. There are more than 400 varieties of medicinal plants such as the rhizome of Chinese goldthread, dangshen [Codonopsis pilosula], Chinese angelica, eucommia [Eucommia ulmoides], and the tuber of elevated gastroidia [Gastroidia elata] that are famed throughout China and the world. There are more than 100 kinds of wild fodder. In addition, there are many kinds of wild oil-bearing plants, wild fibers and wild starchy plants.

This region is even more richly endowed with energy resources. In addition to the water power resources of the three gorges of the Chang Jiang, which are famed throughout the world, the Qing Jiang has hydropower reserves of 1,962,000 kilowatts. Hydropower resources of the Huangbai He, the Yuyang He, the Xiangqi He, the Yandu He, as well as of the Qian Jiang and Xi Shui, which traverse this region are also extremely abundant. The Chang Jiang aside, this region has hydropower reserves approaching 2,603,700 kilowatts. Coal is also spread widely throughout the region, virtually every county having some, these reserves accounting for close to one-half the province's total reserves. The region also has petroleum and natural gas deposits.

Phosphate mines also abound. Current statistics show about 2 billion tons of reserves, or 80 percent of the province's total. Pyrite ore reserves also total more than 80 million tons. The region also has deposits of iron, copper, zinc, cadmium, sulfur, gypsum, asbestos, salt and crystal.

4. Tremendous Potential of Agricultural Production

Though the southwestern Hubei mountain region has superior natural conditions and plentiful natural resources, the separation brought about by the mountain ranges, the tortuous roads and the faraway location in the southwest corner of the province have long been major impediments to the economic development of the region. Up until the time of liberation, the economy here was choked; production was backward and primitive "slash and burn" clearing of the land for cultivation, then leaving it and moving on was extremely common everywhere. The level of production was extremely low. After liberation, production rose gradually, and following the northern region agricultural conference of 1970, in particular, a new upsurge was sparked in the building of mountain regions, with some advanced agricultural production units coming to the fore. Throughout the region, grain output in 1978 was 1.8 times that of 1949, and substantial development of forestry and economic diversification also occurred. For some mainstay varieties, output increased from several times to several tens of times. Great changes also took place in farming patterns. Formerly, for example, raw lacquer and the rhizome of Chinese goldthread [Coptis chinensis] production had been concentrated at Lichuan, but now all other counties are producing them. However, overall speed of economic development of the southwestern Hubei mountain region has not been fast, and the backward state of agricultural production has not changed fundamentally. Statistics for 1978 show grain yields for the southwestern Hubei mountain region to have been 583 jin per mu, or 201 jin lower than for the province as a whole (784 jin). In terms of total population, each person averaged 675 jin of grain, 79 jin lower than for the province as a whole (754 jin). Yields per unit of area of the staples of economic diversification were relatively low and quality poor. For some products such as raw lacquer, silkworm cocoons, Chinese angelica and ramie, output has yet to reach all-time high levels. Commune member earnings have remained lower than the average for the province.

Impediments to development of the southwestern Hubei mountain region are numerous, and one of the principal ones is poor communications and difficulties in moving around. Development of communications and transportation is crucial to full use of this region's abundant natural resources, to making the most of its tremendous production potential, and to developing further the mountain region economy. Today navigation of the Chang Jiang forms the principal connection between the region and the outside world. Though highways connect every county in the region, most commune and brigade transportation is done on the backs of people. Not only does this use a large amount of rural labor to the detriment of agricultural production, but since only so much can be hauled by manpower, movement of agricultural sideline products, and of materials to support agriculture as well as sundries used in daily life is very slow. This means work does not get done in the right farming season,

both production and the people's livelihood suffering as a result.[1] It also means that goods frequently accumulate in inventory where spoilage increases, or where they mildew and rot, causing extremely great waste. In addition to making full use of Chang Jiang navigation and hurrying the building of Badong Port, plus harnessing the Qing Jiang and considering development of navigation on the Qing Jiang, it will also be necessary to build highways energetically. Highway building should be made a part of state economic plans and farmland capital construction plans. The pace of construction should be accelerated for rapid improvement of transportation within a certain period of time so as to remove obstacles to development of the mountain region economy.

Hastening the pace of mountain region construction also means accelerating mountain region agricultural mechanization. In 1978, the southwestern Hubei mountain region used a total of 448,900 horsepower, each production brigade averaging 81.8 horsepower, which was only 28.8 percent of the provincial average (284.08 horsepower). Use of chemical fertilizer averaged 44.7 jin per mu of cultivated land, which was 79 percent of the average for the province as a whole (56.6 jin). The mountain region labor force is too small; fields are spread out; farming operations are of many kinds; the work seasons are concentrated; transportation is strenuous; and farmland capital construction tasks are numerous. Mechanization cannot wait; the need for all kinds of farm machines of different horsepowers is extremely urgent.

In order to advance agricultural development, reliance on local resources for active development of mountain region basic industry is extremely important. The mountain region has no basic industry and must rely on the outside for supplies of everything. This not only greatly increases transportation costs, but must inevitably delay development of agriculture.[2] In this region, water energy, coal, iron ore and construction materials are found everywhere. Reserves are abundant and small industries could be built to process them in order to hasten the pace of the region's farmland capital construction and agricultural mechanization. In addition, this region has abundant farm, forestry and locally specialized products, which should be developed in combination with economic diversification. All kinds of commune and brigade enterprises can be operated that obtain materials locally and process them, in a close linking of industry and agriculture for the advancement of both.

1. In order to assure agricultural production, every spring transportation of everything but materials used in agriculture is halted in Enshi Prefecture.
2. Cement is an example. The ex-factory price of cement from the Echeng Cement Plant is between 40 and 50 yuan per ton. By the time it is hauled to Chengguan in Enshi, it costs about 105 yuan, and when hauled to farmland capital construction sites, it costs as much as 200 yuan in some places.

Chapter 9. Northwestern Hubei Mountain Region

This region is located in the northwestern part of the province and is part of the western Hubei mountain region. On the east it neighbors the northern Hubei uplands; on the south, it connects to the southwestern mountain region; in the west, it borders on Shaanxi and Sichuan, and in the north, it connects to Henan and Shaanxi. It includes Jinxian, Xunxian, Xunxi, Zhushan, Zhuqi, Fangxian and the Shennongjia Forest Zone in Yunyang Prefecture, plus Nanzhang, Gucheng and Baokang Counties and Shiyan Shi in Xiangyang Prefecture, a total of one city, nine counties and one forest zone. This is a land area of about 50,946,000 mu of which 5,550,900 mu is cultivated land. This is about 10.89 percent of the total area of the province. Mountain forests cover about 37.25 million mu, or 73.12 percent of the region's total area. The rural labor force numbers more than 1.3 million. Cultivated land averages slightly more than 4 mu of cultivated land per capita and nearly 30 mu of forestland per capita. People frequently describe this region as being "80 percent mountains, 10 percent water and 10 percent fields."

Table 9-1 Basic Situation in the Northwestern Hubei Mountain Region (1978)

Units: 10,000 mu; 10,000 people

			Percent of provincial total
Total area		5,094.60	18.12
Cultivated land area:	Total	555.09	9.82
	Wetlands	138.21	4.70
	Drylands	416.88	15.37
Total population		418.75	9.15
Agricultural population		373.29	9.56
Average amount of cultivated land per capita of agricultural population (mu)		1.49	

First Section. General Discussion

1. Large Mountains, Small Valleys and Steep Slopes

This region has vast mountain ranges, the mountainland area accounting for more than 80 percent of the total region. These mountain ranges may be divided into four mountain systems as follows: (1) The eastern segment of the Qinling range extending to the northern part of this region; 2) Wudang Shan lying to the south of the Han Jiang in the central part of this region; (3) the eastern part of the Daba Shan traversing the southern part of this region; and (4) the Jingshan Range cutting through the eastern part of this region. They are all deeply affected by geological structure. For example, the Qinling and Daba Shan ranges which run in an east-west direction, and the Jingshan Range, which runs in a northwest-southeast direction, all go in the direction of the strata, and all are largely folded mountain ranges in which the rock formations are compressed very lightly.

Only Wudan Shan is largely a massive metamorphic rock mountainland that has been affected by faulting. One common characteristic of these mountain ranges is the large size of the mountains and the small size of the valleys. Except for a few mountain basins that are fairly wide, most valleys throughout the mountain area are very narrow. The mountain ranges of this region are mostly made up of metamorphic rock and limestone and have a slope greater than 25 degrees. Many mountain slopes descend in a straight line; the spines of the ranges are sharp; the rocks are jagged and the mountain slopes are precipitous, providing conditions for erosion. This is one of the main reasons contributing to runoff of soil and water.

The river valley basins among the mountains vary in size and their height above sea level also differs greatly giving rise to a fairly complex topography within the region. Above Danjiangkou, the Han Shui generally flows through a metamorphic rock zone between the Qinling and the Daba mountains moving from west to east. Sometimes river valleys cut across rock formations. Gorges alternate with basins. Going from west to east in sequence are Yunyang Basin, Zhaojiaba Gorge, Anyang (town) Basin, Huangjiawan Gorge, Junxian Basin and Danjiangkou Gorge. River valleys within the basin are fairly broad and near Yunyang the river bed is 500 meters wide. Within river valleys, meanders are also well developed. Between Daba Shan and Wudang Shan lie the Fangxian, Zhushan and Zhuqi river valley basins within the mountains and the hill and low mountain region, which are crossed by the Du He and Nan He on the southern shore of the Han Jiang. Basins within the region may be divided into two main types: One is basins deposited by the red rock system of the Tertiary Era in the shallow undulating hills, such as Yunyang Basin and Junxian Basin. The other kind is sunken regions formed by geologic structures or else basins formed by erosion of soft rock formations such as Zhuqi and Fangxian Basins. In these river valley basins, the land is flat and the slopes gentle. There is a substantial amount of flat land on which surface waters converge. Both water and soil conditions are rather good; the soil layer is thick and friable; its capacity to hold water is fairly great; ability to conserve water is fairly strong; and soil

fertility is fairly high, making such basins good places in mountain regions for agricultural production and particularly for grain production. The eastern fringe of the Jingshan Range has turned into an upland region. Nanzhang and Gucheng Counties have become semimountain areas whose hills and flatlands are fairly flat and wide. They are the principal grain growing areas in the region.

The streams of this region are primarily the Han Jiang and its tributaries, the Du He and the Nan He. River valleys of the upper and middle reaches of the Han Jiang traverse the northern part of this region from east to west. The Du He and Nan He, which originate on the northern slope of the Daba Shan, flow from south to north into the Han Jiang. In addition, numerous small rivers and mountain ravines carry waters off the mountains.[1] Though volume of annual precipitation in this region is not as great as elsewhere in the province, it is still more than 800 millimeters, and the volume of water in streams is still rather plentiful. The incline of the land, and the fairly great drop of river beds produce a rapid current that provides plentiful water conservancy and water energy resources. Since liberation, this region has built quite a few reservoirs. Looked at in terms of utilization of water energy resources alone, in addition to the Danjiang hydroelectric station (900,000 kilowatts), the Huanlong hydroelectric station (150,000 kilowatts), the Sandao He Hydroelectric station at Nanzhang (4,860 kilowatts), as well as the Pankou hydroelectric station (225,000 kilowatts) designed to be built at Zhushan in the middle reaches of the Du He, this region also has substantial medium size and small hydroelectric resources. Reserves have been estimated at more than 500,000 kilowatts and they are distributed over a fairly wide area.

2. North Semitropical Monsoon Climate

This region is located at mid-latitude. To the north lies the Qinling barrier; in the south is the Ba Shan divide. The overall terrain is high in the west and low in the east. This both makes for easy penetration of the southeastern monsoon, and weakens the influx of cold air from the north. For this reason, winters in this region are milder than in other places at the same latitude. Summers are stiflingly hot with much rainfall, the annual temperature averaging around 15°C, and precipitation averaging more than 800 millimeters per year. It is part of the northern semitropical monsoon climate.

The agricultural climate of this region is characterized as follows:

1. Ravines are a common feature of mountain region counties. Take Baokang, for example, where in addition to the Nan He, the county has 3,369 large and small ravines including 52 small streams totaling 592 kilometers in length. It has 178 large ravines totaling 723 kilometers in length. All these ravines converge into three main streams, which empty, in turn, into large rivers.

1. Relatively Plentiful Light and Heat Resources

Sunshine averages between 1,616 and 1,957 hours annually and annual radiation totals between 103 and 112 kilocalories per square centimeter. Though somewhat less than in northeastern and northern Hubei, it is no less than in the low mountain and hill region of southeastern Hubei, and more than in the southwestern mountain region of Hubei. In terms of heat energy, not only is the annual average temperature fairly high, but winters are mild. During the coldest month (January), temperatures average 2° - 3°C, about 1°C higher than in northern Hubei. Cumulative temperatures greater than 10°C for the area range from 4,500°C-5,100°C and continue for from 220 to 230 days. The frost-free period is about 220-256 days. This helps crop growth and increases the multiple cropping index. With rational planning and economic use of heat, the production potential is very great.

2. Good Match of Rainfall and Warmth During the Same Season

Summer (June-August) is when crop growth is liveliest, and the time when much heat and large amounts of water are needed. It is precisely during this season that this region gets the most plentiful heat and the largest amount of rainfall. Except for the high mountains, average temperatures during the summer months are higher than 26°C and accumulated heat is plentiful. Summer precipitation runs to between 330 and 430 millimeters, which is between 37 and 47 percent of total precipitation for the year. If used sensibly, this is sufficient to satisfy needs in regions where grain is grown on drylands. Precipitation is least during winter in this region amounting to only about 5 percent of total precipitation for the year. This is the region of the province that gets least winter rainfall. Rainfall is about equal during spring and autumn, with a little more rainfall during spring than autumn in the northern part of the region.

3. Climate Greatly Affected by Topography; Complex and Varied

The mountain region climate is affected by numerous factors such as elevation above sea level, the direction in which slopes face and vegetation cover. The masses say, "a change with each zhang rise in elevation," by way of stating the differences in climate brought about by changes in elevation above sea level. Measurements made in Fangxian and Zhushan Counties show that for every 100 meter rise in elevation, temperature drops by about 0.7°C. Within limits, the greater the elevation, the more precipitation. (See Table 9-2)

The direction in which slopes face has a marked affect on temperature. Generally speaking, temperatures on northern slopes are lower than on southern slopes. Yunyang Prefecture Meteorology Station measurements of temperatures on shaded and sunny slopes in the mountainlands of Fangxian showed that at 10 am on clear days, temperatures on sunny slopes were 2.8°C higher than on shaded slopes, and that the difference in temperature averages 1.1°C between 0700 and 1900 hours. This made an extremely marked difference on crop growth and ripening.

Table 9-2 Comparison of Agricultural Climate at Different Elevations

(a) 地点	≥5℃			≥10℃			气温(℃)		积温(℃)		f 年降水量 (MM)	(g) 平均无霜期 (天)
	b 始现日期	c 终现日期	d 持续日数	b 始现日期	c 终现日期	d 持续日数	≥5℃ (e) 期间	≥10℃ (e) 期间	≥5℃ (e) 期间	≥10℃ (e) 期间		
(h) 穷县城关(盆地)	6/3	30/11	270.2	4/4	5/11	215.9	18.4	21.2	4,942.8	4,449.5	817.4	225
(i) 土城(二高山)	16/3	22/11	251.5	15/4	28/10	196.8	17.5	19.8	4,394.7	3,883.3	—	—
(j) 上龛(高山)	16/4	31/10	199.4	14/5	25/9	135.1	14.4	16.6	2,855.6	2,239.4	884.9	217

Key:
a. Place
b. Beginning date
c. Ending date
d. Number of consecutive days
e. Time period
f. Annual precipitation (millimeters)
g. Average frost-free period (days)
h. Chengguan (Basin), Fangxian County
i. Tucheng (secondary high mountain)
j. Shangkan (high mountains)

The diverse mountain region climate provides fine conditions for development of economic diversification.

4. Considerable Disastrous Weather With Much Danger of "Neck Wrenching"

The major disasters this region faces come from drought, torrential rains, low temperatures with continuously rainy and overcast weather, autumn winds and hailstones. Torrential rains during August 1975 brought calamitous flooding and waterlogging damage to Baokang and Fangxian. Autumn winds strike early in high mountain regions, usually beginning in early September and frequently they are accompanied by autumn rains, which is bad for production of late rice and corn. Hailstones are a disastrous kind of weather that affects only parts of the area. Hailstones have occurred in every county in the region, usually during spring and summer, and with greatest frequency during March and April. Though each hailstorm is of short duration, it can cause serious damage. An example was the hailstorm that occurred in Fangxian on 4 June 1972 that affected 22 production brigades and damaged 3,680 mu of summer grain crops plus 3,990 mu of crops to be harvested in the fall, ruining more than 800,000 jin of grain. Clearly understanding and mastering the occurrence of hailstorms and the laws governing their occurrence, plus prompt defensive action against them is of major importance.

Of all the kinds of calamitous weather, the one that causes greatest damage to production and the one that occurs most frequently is "neck wrenching drought." So-called "neck-wrenching drought" refers mostly to a drought that occurs during the key period when corn needs water. Each year this region has varying degrees of drought, summer drought being most serious. Statistics show a greater than 80 percent chance of summer drought (in Fangxian, the probability is somewhat less at 70 percent). Summer drought usually occurs

from mid-July to the end of August. This is just the time when corn stamens differentiate into small ears and small flowers, requiring increased amounts of water. Severe drought must inevitably lead to failure of corn to tassel. For this reason, the local people term such a drought a "neck-wrenching drought" [presumably because they must carry water in buckets hung from poles slung across their shoulders, craning their necks]. In recent years with restructuring of the farming system, vigorous efforts have been made to spread the intercropping of wheat and corn, which has substantially avoided the damage to corn caused by summer drought. However, after the sowing time for corn was advanced, early summer drought increased corn damage or even became a "neck-wrenching drought" for main crop or second crop corn.

3. Much Ground Cover in the South; Little in the North

As a result of the complex and diverse climate, and the great variation in the lay of the land, this region has many kinds of ground cover including semitropical and temperate zone plants.

The pattern of ground cover is much in the south and little in the north (see Table 9-3). In three counties in Yunyang Prefecture (Zhuzhang, Zhuqi and Fangxian), in the Shennongjia forest zone, and in Nanzhang, Baokang and Yucheng Counties in Xiangyang Prefecture, bald mountains are few in number and the vegetation cover rate is fairly high. Forestlands are more than 50 percent of the mountain forest area, or even as much as 60-70 percent. In the Shennongjia forest zone, in particular, forest cover has been quite well preserved. Survey shows marked vertical zoning in the pattern of vegetation. There are more than 2,000 kinds of vegetation, or two-thirds the kinds of vegetation found throughout the province. This is the place of most abundant forest resources in the province.

Table 9-3 Barren Mountain Area Suited to Forests in the Northwestern Hubei Mountain Region

Units: 10,000 mu

	Barren mountain area	Percentage of mountain forest area (percent)
Junxian	112.3	36.6
Yunxian	186.8	46.2
Yunxi	157.3	42.7
Zhushan	111.1	31.0
Zhuqi	95.9	29.3
Fangxian	119.9	23.6
Nanzhang	47.6	14.3
Gucheng	32.4	9.6
Baokang	21.2	9.0
Shiyan City	41.3	29.4
Shennongjia	57.2	14.3

The forest cover rate is low in the three northern counties of Yunyang Prefecture (Junxian, Yunxian and Yuxi Counties), where barren mountains cover more than 4.56 million mu, which is virtually half the barren mountain area in the region suited to forests. As a result, erosion is extremely severe in these counties. Surveys show a runoff area of more than 2,675,000 mu on barren mountains in Yuxi County. This is 65 percent of the slope area suited for forests. In many areas, the least concentration of rainfall means mountain torrents and mud slides that choke streams and destroy good farmland. Thirty percent of the 106 reservoirs with a total capacity of more than 100,000 cubic meters that have been built in this county have become so silted as to become stagnant. As a result of steady rise in the river bed, only 6 of the 13 stories of an ancient 14 meter high pagoda beside the Daba He in Dianzi Commune now protrude from the surface of the land. Therefore, afforestation and growing of grass (Chinese alpine rush) [Eulaliopsis binata] to green the barren mountains and conserve soil and water is a matter that will brook no delay. It will be necessary to intensify further the afforestation of barren mountains suitable for forests and to increase the vegetation cover rate. It will be necessary, as well, to intensify replanting of scrub woodlands in order to tap to the full the huge potential of plant cover resources in this region.

4. Not Very High Level of Agricultural Production

This region has chain upon chain of mountains and deep valleys with steep slopes. Transportation is not well developed, and slopes account for a substantial proportion of cultivated land. As a result, the people here say that here there are "vertical roads, and hanging fields." Since liberation, the people of this region have carried forward a revolutionary spirit of rearranging the mountains and rivers in a war against nature for preliminary improvement in agricultural production conditions, which has brought substantial development of agricultural production. However, as compared with other parts of the province, this region's level of agricultural production is still fairly low. Take grain output, for example, (see Table 9-4) which was 2.657 billion jin in 1978. Though this was more than double the 1949 output (998 million jin), it was only 7.7 percent of total grain output for the province as a whole. In 1978, yields from areas sown to grain averaged only about 302 jin per mu for the area as a whole, far below the average 415 jin per mu for the province as a whole. The region's average 634 jin of grain per capita was lower than the 754 jin per capita for the province as a whole.

In the area of economic diversification, the people of this region have used the favorable conditions provided by the mountains' wide open spaces and diverse climate to score definite accomplishments. It holds an important place in the province in production of many things such as wood fungus, Chinese alpine rush, raw lacquer, walnuts and tung seeds (see Table 9-5). Baokang and Fangxian Counties' black and white wood fungus, Zhuqi's raw lacquer, Yunxi's rung seeds and walnuts, Yunxian's Chinese alpine rush, Junxian's tussah silkworm cocoons, Nanzhang's mulberry silkworm cocoons and Zhushan's Chinese gallnuts, and coir fiber are all very famous. The area also produces numerous medicinal materials such as dangshen [Codonopsis pilosula], the rhizome of

Table 9-4 Grain Increase in the Northwestern Hubei Mountain Region

Units: 100 million jin

Grain output \ Year	1949	1957	1966	1978
Total for province	115.63	197.21	240.38	345.12
Grain output for northwestern Hubei mountain region				
Total	9.98	15.76	17.22	26.57
Percentage of provincial total	8.63	7.99	7.16	7.70
Junxian	1.01	1.82	1.72	1.99
Yunxian	1.84	2.39	2.11	3.04
Yunxi	0.97	1.21	1.46	2.02
Zhushan	0.99	1.56	1.63	2.74
Zhuqi	0.89	1.30	1.37	2.18
Fangxian	1.03	1.78	1.95	3.08
Nanzhang	1.36	2.63	3.22	5.00
Gucheng	1.24	2.10	2.02	3.72
Baokang	0.65	0.97	1.27	1.95
Shiyan City			0.47	0.48
Shennongjia				0.37

Table 9-5 Major Local Specialties of the Northwestern Hubei Mountain Region and Their Position in the Province

Units: Dan

Item	Output for this region	Percentage of provincial total
White wood fungus	2,520	91.97
Black wood fungus	13,546	84.44
Raw lacquer	2,288	30.21
Chinese alpine rush (10,000 jin)	1,988	72.66
Tung seeds	292,059	41.96
Walnuts	44,909	40.92
Tussah silkworm cocoons	16,552	74.80
Chinese gallnuts	494	8.6
Medicinal materials	54,383	20.28
Apples	14,016	26.46
Citrus	136	0.18

Note:

Since the 1960's, the growing of citrus fruit has developed rapidly in this region. In 1975, output was 15,691 dan. As a result of a serious freeze in January 1977, output has declined in recent years.

Chinese goldthread, and the bark of eucommia. In recent years, it has also introduced and propagated citrus fruit and apples. A group of economic diversification bases have also been established one after another. However, in an overall sense, economic diversification has not developed rapidly, and both the level of scientific management and yields per unit of area are relatively low. Output of a small number of principal products has not yet reached all-time high records, and earnings from economic diversification is still a not very large proportion of gross income from agriculture.

Part III. Exploration of Various Problems in the Modernization of Agriculture

Comrade Mao Zedong pointed out that "In the production struggle and in scientific experimentation, mankind develops constantly and can never stop at a given level." ("Major Documents of the First Session of the Third National People's Congress of the People's Republic of China".) The 3d Plenary Session of the 11th Party Central Committee decided that in order to effect a shift of the whole party's work focus and hasten the pace in building socialist modernization, it is now necessary to concentrate major energies to the improvement of agriculture. In the 30 years since liberation, despite substantial development of agricultural production in Hubei Province, modernization will still require arduous efforts over a long period of time. Here we will make a preliminary exploration of various problems bearing on modernization of the province's agriculture for the reference of those concerned in carrying out further study.

Chapter 10. Strive To Build Fields From Which Consistently High Yields May Be Assured Despite Drought or Waterlogging

The Central Committee's "Decisions Relating to Various Problems in Hastening Development of Agriculture" pointed out the need to "continue resolutely and vigorously to adapt general methods to specific circumstances for good performance in agricultural capital construction needed for farming, forestry, animal husbandry, sideline occupation and fisheries production, and for storage, transportation and processing. Agricultural regions that produce grain primarily should continue to focus on harnessing waters and improving soils, and the energetic planting of trees and growing of grass to tackle problems with mountains, waters, farmlands, forests and roads in a comprehensive way, to act to transform production conditions gradually, to improve capabilities to withstand natural disasters, and to build farmlands that produce consistently high yields despite drought or waterlogging." It is a glorious yet arduous task that confronts us at the present time.

First Section. Statement of the Problem

During the 30 years since the founding of the People's Republic, an accumulated more than 13.4 billion cubic meters of earth and rock have been moved in capital construction of the province's farmland. The scale of projects has steadily expanded and both speed of completion and quality have steadily improved. During the past several years, between 7 and 8 million people have worked at construction during peak periods, and have moved more than 1 billion cubic meters of earth and stone to bring mountains, waters, fields, forests and roads under comprehensive control. They have improved agricultural production conditions to a substantial degree. The particularly severe provincewide drought of 1978 rigorously tested water conservancy facilities, but a bumper crop was harvested in a remarkable display of effectiveness. Nevertheless, numerous weak links also came to light, which showed that farmland capital construction is still a long way from meeting standards.

1. A harvest can be assured despite drought or waterlogging from only 31 million mu, or 55.5 percent, of the province's total cultivated land area. This averages 0.8 mu per capita. This includes 17.5 million mu of farmland that produces consistently high yields, or an average 0.45 mu per capita. The proportion of farmlands in peripheral mountain areas from which consistently high yields can be harvested and that produces a harvest despite drought or waterlogging is even lower (see Table 10-1), and a fair number of counties are not self-sufficient in grain. At the current rate of population increase, by 1985, the province's agricultural population will have increased to 42 million. To meet the requirement of 1 mu of basic farmland per capita, a 24 million mu increase in fields producing consistently high yields will have to take place. This means an average increase of 3.4 million mu each year. Under present circumstances, without a speed up in construction, this arduous task cannot be completed.

2. There are still between 4 and 5 million mu that are prone to waterlogging and 17 million mu of unserved drylands requiring the building of drainage and irrigation facilities. Antiflood capabilities in plains lake regions also require upgrading and solution must be found to the problem of irrigation during spring drought and to the problem of improving the area currently being drained. For large irrigation areas in hill regions, the problem of sources for the replenishment of water supplies must be solved. In mountain regions, not only must the problem of cultivated land irrigation be solved, but drinking water for almost 1 million people and 500,000 head of livestock is another problem that must be solved.

3. Problems in harnessing the land are an even more arduous task. Only a little more than 5 million mu of the more than 11.6 million mu of cultivated slopes in the province's mountain and hill regions have been terraced. In hill and plains regions, an additional more than 17 million mu of mostly flat but partly uneven cultivated land requires leveling. Nearly 10 million mu of cold, muddy, clayey, gravelly and infertile fields of low productivity urgently require improvement. Additionally, mountain and hill regions have an

Table 10-1 Current Agricultural Land in Hubei Province

(a) 地市	(b) 农业人口 (万人)	(c) 旱涝保收 面(d)积 (万亩)	人(e)平 (亩)	(f) 高产稳产 面(d)积 (万亩)	人(e)平 (亩)	(g) 到一九八五年 人口预计(h) (万人)	新增旱涝保收农田(i) (万亩)	新增高产稳产农田(j) (万亩)
Province as a whole	3,905.73	3,117.33	0.80	1,755.82	0.45	4,183	1,117	2,426
Huanggang	613.33	436.34	0.72	296.76	0.49	660	224	362
Xiaogan	507.13	362.08	0.71	284.03	0.56	540	178	256
Xianning	304.18	222.68	0.73	128.63	0.42	330	107	201
Jingzhou	948.67	1,054.86	1.11	525.11	0.55	1,010	—	485
Xiangyang	489.12	369.75	0.75	156.18	0.32	530	160	374
Yunyang	241.98	97.14	0.40	60.9	0.25	260	163	199
Yichang	292.99	194.27	0.66	109.69	0.37	310	116	200
Enshi	294.29	179.61	0.61	110.84	0.38	315	135	204
Shiyan	12.97	2.25	0.17	1.18	0.09	14.0	11.0	13.0
Huangshi	67.71	49.32	0.73	25.1	0.38	72.0	23	47
Wuhan	133.36	149.03	1.12	57.4	0.43	142.0	—	85

Key:
a. Prefecture or city
b. Agricultural population (10,000 persons)
c. Guaranteed harvest despite drought or waterlogging
d. Area (10,000 mu)
e. Per capita average (mu)
f. Consistently high yields
g. By 1985
h. Estimated population (10,000 persons)
i. Newly added farmland from which harvests may be assured despite drought or waterlogging (10,000 mu)
j. Newly added consistently high yield fields (10,000 mu)

additional more than 30 million mu eroded area that has to be brought under control.

4. Development of small rural hydroelectric power stations is far from able to meet current commune and county needs for development of agricultural production. Water power resources have not yet been fully developed and put to use.

5. Farmland capital construction has been uneven. The problem of drought in Hubei's northern uplands and in the province's central hill region, the problem of waterlogging on the Jianghan Plain, and problems in harnessing water to generate electricity and terracing slopes in the province's western mountain region are considerable.

Standards that the Provincial CPC Committee has proposed for farmlands to produce harvests despite drought or waterlogging and to produce consistently high yields are as follows: Leveling of the land, improvement of the soil, conservation of water, conservation of soil, and conservation of fertilizer. Safety should be assured should a flood of the Chang Jiang on the 1954 scale occur, or should an especially great flood on the scale of the Han Jiang in 1964 occur, or should reservoirs be taxed with a downpour of maximum local proportions. It should be possible to withstand a drought lasting from 70 to 100 days, or a torrential rain such as occurs once every 10 or 20 years, promptly draining waterlogging to assure a bumper harvest. Farm machinery operations should be adopted, and grain, cotton and oil-bearing crop yields should exceed the "national program." In view of these requirements, capital construction of the province's farmlands should focus on commodity grain and cotton bases on the Jianghan Plain, in central Hubei and in northern Hubei, as well as in the western mountain regions of the province. It is necessary to continue to solve problems with flood and drought disasters on plains lake areas. Water resources should be developed for large-scale irrigation areas where water resources do not suffice and for places not currently served by irrigation, with the building of a group of needed main projects for the storage, diversion and lifting of water. In mountain areas, the emphasis should be on soil improvement and harnessing of water, with vigorous development of small-scale water conservancy and spray irrigation, the development of soil conservation work, effective control of soil and water runoff, stabilization of the cultivated land area, expansion of basic farmland, raising grain output and active development of mountain region hydropower resources for a transfiguration of mountain regions.

Second Section. Continued Harnessing of Water, Development of Irrigation and Increase in Farmland That Assures a Harvest Despite Drought or Waterlogging

In accordance with the principle of balanced supplies of water, harnessing of water by all jurisdictions should be done in accordance with individual realities, different methods being adopted.

1. Preliminary Calculation of Balance in Supply and Demand for Water by Farmlands Throughout the Province

Figuring a balance in supply and demand for water is a prerequisite to understanding the present circumstances, determining future tasks, and formulating long-range plans. A preliminary analysis of balanced supply and demand for water over the short run and the long run for the whole province is attempted below.

Since measurement data on the amount of irrigation water required by various kinds of crops as derived from scientific experiments is lacking, in calculating a balanced amount of water over the short run, fairly commonly used quotas used in planning by various jurisdictions have been adopted for use, i.e., 800 cubic meters per mu for wetlands, and 300 cubic meters per mu for drylands. However, in the western mountain region of Hubei, only a small area grows two crops of paddy; much of the cultivated land is on slopes; and the proportion of dryland grain is large. Thus, for wetlands in Yunyang and Enshi Prefectures, the amount has been set at 600 cubic meters per mu for wetlands, and at 200 cubic meters per mu for drylands. For Yichang Prefecture, the amount has been set at 700 cubic meters per mu for wetlands, and 250 cubic meters per mu for drylands. These standards for needed amounts of water are fairly high and should no rain fall for 70 consecutive days, at these standards the assured irrigation rate would be 75 percent. However, in view of the difference between a customary mu and a standard mu, the fairly large amount of leakage from irrigation canals, plus not very good irrigation methods, and all problems that will require a process for solution, it should be said that these standards are fairly suitable, nevertheless. For calculation results, please see Table 10-2.

Results of the foregoing calculations show a near term shortage of 4.11 billion cubic meters of farmland irrigation water for the province as a whole. Since Huanggang and Xianning Prefectures have a substantial reservoir capacity for the generation of electricity, they appear to have a surplus supply of water. But if water storage capacity used solely for the generation of electric power is deducted, the province lacks an estimated no less than 6 billion cubic meters of water. The western mountain region of Hubei is a severely water-short area lacking a total of more than 2 billion cubic meters, or nearly one-half the province's total deficit. Most of the drought-prone area of the province is located here. Though the low mountains and hills of eastern Hubei and the Jianghan Plain also lack water, generally speaking, they are close to being in balance (statistics on the amount of water diverted by Xiaoen Prefecture are too low, so total water shortage is somewhat large).

Table 10-2 Calculations on Balanced Short-term Supply and Demand for Water in Hubei Province

Units: Cultivated land: 10,000 mu; quantity of water: 100 million cubic meters

(a)地区 \ (b)项目	(c)耕地面积 (d)合计	其(e)中 水(f)田	其(e)中 旱(g)地	(h)需水量 其(e)中 水田需水j量	其(e)中 旱地需水j量	(d)合计	k蓄引提有效水量 (d)合计	立(l)方米/亩	水量平衡(m) (±)
Province as a whole	5,754.5	2,994.2	2,740.4	221.14	73.8	294.99	253.89	442	−41.1
Huanggang	626.36	437.31	189.05	34.98	5.52	40.5	43.765	700	+3.265
Xiaogan	567.2	400.8	166.4	32.06	4.99	37.05	28.325	500	−8.725
Xianning	406.45	259.05	147.4	20.72	4.42	25.15	28.212	695	+3.06
Jingzhou	1,694.5	971.7	722.8	64.74	21.68	86.42	83.945	495	−2.47
Xiangyang	851.8	420.5	431.3	33.64	12.94	46.58	38.715	455	−7.86
Yunyang	367.69	64.45	303.24	3.87	6.06	9.93	3.967	108	−5.97
Yichang	445.86	159.19	286.67	11.14	7.18	18.32	13.094	293	−5.23
Enshi	476.67	121.67	355	7.3	7.1	14.4	2.985	63	−11.42

Key:
a. Prefecture
b. Particulars
c. Cultivated land area
d. Total
e. Including
f. Wetlands
g. Drylands
h. Required amount of water
i. Wetlands water needs
j. Drylands water needs
k. Effective amount of water impounded, diverted, or lifted
l. Cubic meter/mu
m. Water volume balance ±

However, imbalance exists within prefectures, counties and communes, with some places being prone to drought or not served by irrigation. It must be noted here that the proportion of water diverted in plains lake areas is extremely large, but storage capacity in these areas is lacking. In drought years when the level of rivers flowing in from elsewhere drops and water diversion becomes difficult, widespread drought may still occur.

Lack of figures on the directly usable cultivated land area and the ratio of wetlands and drylands makes it difficult to figure long-term balance in the amount of water. Thus, it is only possible to proceed from an analysis of present circumstances to consideration of the possibility of further increase in the land utilization rate after the land has been leveled and the soil improved for garden style farming. Long-range capabilities to withstand drought call for all areas to have enough water to be able fully to satisfy crop growth needs for 100 days, i.e. to be able to harvest a bumper crop despite 100 days of drought, and to assure high paddy yields without rainfall. It is realized that future equipping of field engineering works plus

achievement of high standards in garden style farming, as well as gradual spread of the use of underground irrigation canals and spray irrigation technology that use water scientifically and that conserve water will make this fully possible. Therefore, the foregoing figures have been used as irrigation norms, and the proportion of wetlands to drylands and the amount of water used in small areas have been extrapolated from the recent situation (see Table 10-3 and Table 10-4).

Table 10-3 Estimate of Long-term Cultivated Land Area in Hubei Province

(a) 类型	(b) 自然面积 (万亩)	(c) 1975 年耕地面积				(d) 估计远景可达耕地面积		
		面(e)积 (万亩)	(f)土地利用率 (%)			土地利用(f)率 (%)	面积(e) (万亩)	比1975年增加数(j) (万亩)
			平均(g)	最大(h)	最小(i)			
(k)全省	28,110	5,734	20.4	50.3	7.15	29	8,158	2,424
(l)山区	14,730	1,743	11.9	17.9	7.15	17	2,499	756.32
(m)丘陵	7,670	1,817	23.7	40	15	33	2,524	706.48
(n)平原	5,710	2,174	38.1	50.3	30	55	3,135	961.2

Key:
a. Kind of region
b. Natural area (10,000 mu)
c. Cultivated land area in 1975
d. Estimated attainable land area over long-term
e. Area (10,000 mu)
f. Land utilization rate (percent)
g. Average
h. Maximum
i. Minimum
j. Increase over 1975 (10,000 mu)
k. Province as a whole
l. Mountain region
m. Hill region
n. Plains

Table 10-4 Calculations on Long-term Water Balance in Hubei Province

	(a)耕地面积(万亩)			(f)总需水量(亿立方米)			现控制水(g)量 (亿立方米)	水量平衡差(h)额 (亿立方米)
	(b)合计	其(c)中		(b)合计	其(c)中			
		水(d)田	旱(e)地		水(d)田	旱(e)地		
(i)全省合计	8,158	4,242	3,916	418	320	98	254	−164

Key:
a. Cultivated land area (10,000 mu)
b. Total
c. Including
d. Wetlands
e. Drylands
f. Total volume of water needed (100 million cubic meters)
g. Current volume of water controlled (100 million cubic meters)
h. Deficit in achieving balance in water volume (100 million cubic meters)
i. Total for province

2. Launching Basinwide Control and Strengthening Capabilities To Dam Flood Waters and Impound Water

On the basis of the foregoing calculations of balance between supply and demand for water, over the long-term the province will lack 16.4 billion cubic meters of irrigation water. This is roughly equivalent to the province's total water storage capacity. Though water diversion and water lifting capabilities may be improved somewhat to solve the water shortage to some extent; nevertheless, obviously the limitations of the situation make satisfaction of demand impossible, and additional projects for the impounding of water will have to be built. Only when the province's capabilities to dam up and impound water meet or exceed more than 40 percent of the total runoff of 100 billion cubic meters of water in the province, will balance be attained. In addition to continuing to tap the potential of existing water conservancy projects, other means of solution include continuation of the policy of "primarily small scale, primarily integration and primarily commune and brigade operation." The masses must be relied on for the building of small-scale water conservancy projects in a greater, faster, better and more economical way to solve irrigation problems within a short period of time. At the same time, a large number of major basinwide projects must be built as insurance and to solve in a fundamental way the problem of sources of irrigation water to withstand major drought.

(1) Continued Attention to Integrating the Existing 31 Irrigation Areas

During the next several years, efforts will have to be made to integrate projects for the irrigation of between 4 and 5 million mu that have not yet attained designed effectiveness, and integration of the Zhang He, Chiwei, Yindan, Dongfeng, Fuqiu, Tangdong and Huasha irrigation areas must be solved in particular. These are in hill and upland regions and though some master projects exist there since the irrigation area is large and irrigation canals long, in addition to which spring and summer droughts with little rainfall have occurred during the past several years, the water shortage is rather serious. It will be necessary to continue to take a firm hand in the integration of projects in the future in order to connect reservoirs with each other, link reservoir canals and be able to irrigate fields in countless places by releasing water from a single place in a gravity irrigation system that spreads out like a vine and produces fruit. It will also be necessary to expand water sources to make up for the lack of water in existing projects. Huanggang County devoted many years to the harnessing of water by building the Xiangshui Tan and Niuche He master reservoirs, plus the Hengshi and Xiashichong as part of nine medium and small size reservoirs. It linked all reservoirs to each other in a centralized gravity irrigation network. When water for the reservoirs is lacking, waters from the Ba He are sent through the Maan Shan tunnel (for the Xiangshui Tan, Niuche He, Xiashichong, and Miao He reservoirs) and linking the waters of the Dao Shui (to the Heng He, Jinpen, Fu He No 1, Fu He No 2, and Kongzi He reservoirs), water from places with a surplus being moved to places with a shortage for solution to the problem of insufficient irrigation water over a 500,000 mu area. This county's methods deserve to be applied elsewhere.

(2) Particular Need To Take Firm Hold of Mountain Region Water Conservancy in Development of Small-Scale Water Conservancy

The province's small reservoirs are currently able to impound 4 billion cubic meters of water, and dammed ponds can impound an additional 2.8 billion cubic meters. Techniques are simple for building small water storage projects; construction is relatively easy; investment is relatively small; and the projects are close to farmlands for which irrigation water is available at once. With development of agricultural production and increase in the level of scientific farming, only small-scale water storage projects will be able to meet needs in using water to regulate temperature, using water to regulate fertilization, using water to regulate the air, and insuring that irrigation water is delivered at the right times in the right amounts as needed. For the long-range development of agriculture, the significance and role of small water storage projects will most certainly not decrease, but will become greater and greater. Furthermore, master reservoirs must have a number of small-scale projects as a foundation. When these small projects are used to redistribute water and get it into the fields, the water can be used with greater effectiveness.

Today, more than 17 million mu of farmland in the province is without water conservancy facilities. Most of this land is located on the fringes of large irrigation areas where the terrain is very high, and in the province's western mountain regions. The natural geography of these places produces small, scattered field plots where the land slopes greatly and water resources are lacking. Though such terrain does not favor building of large or medium size master projects, it is quite suitable to development of large ponds and small reservoirs that could dot the landscape like stars in the heavens. However, small reservoirs and dammed ponds are seriously lacking in such areas. In all nine counties of Enshi Prefecture, for example, the number of dammed ponds is only one-ninth the number in Suixian County alone. Figures show that in 1977 the province averaged one dammed pond per 46 mu of cultivated land. In Yuyang Prefecture, however, there was only one dammed pond per 230-odd mu, and in Enshi Prefecture, the average was only one dammed pond per 434 mu. For individual counties such as Badong, it was only one dammed pond for close to 900 mu.

In view of the foregoing situation, the following recommendations are made:

1. Good Planning of Small-Scale Water Conservancy for "Dead Spots" in Irrigated Areas

Large ponds and small reservoirs must be actively built to service dead spots in water conservancy areas. Efforts should be made to build a group of small projects to impound water within the next 3 to 5 years so as to increase by several billion cubic meters the effective amount of water in storage and eradicate dead spots in water conservancy as quickly as possible. At the same time, where conditions permit, master water storage projects and projects for the diversion and lifting of water should be built in order to increase the certainty of being able to withstand drought.

2. Building of Water Conservancy in Mountain Regions Should Be Primarily for the Purpose of Impounding Water

Everything possible should be done to block streams to impound water, so that large ponds and small reservoirs will dot the landscape and provide local irrigation. Existing dammed ponds should be improved upon and other dammed ponds built. Projects for the diversion of water for irrigation should be built on long streams to achieve a combination of water storage and water diversion. In limestone areas, underground karst water should be put to use. Large ponds and small dammed ponds should be built, streams should be dammed, and diversion canals dug so that the number of dammed ponds in mountain regions gradually reaches the average for the province. Take Enshi Prefecture, for example. Using this standard for calculations, more than 100,000 dammed ponds. If each dammed pond is able to hold 3,500 cubic meters of water, total capacity will be greater than 350 million cubic meters. Since Enshi gets copious rainfall, rain falling on a large number of days throughout the year, this prefecture could become the one with the highest dammed pond replenishment rate in the whole province. At a replenishment of 2.5 times, that would mean the dammed ponds alone could provide 900 million cubic meters of water annually, which is three times the current amount of water stored, diverted, and lifted in Enshi Prefecture. Not only would this be enough to assure present farmland irrigation needs, but it could also promote the change of drylands to wetlands and development of irrigation.

3. Speediest Possible Solution to the Problem of Drinking Water for People and Livestock in the Western Hubei Mountain Region

Most places in the province where drinking water for people and livestock is a problem lie in remote mountain regions of 23 counties in the western Hubei mountain region. There the people frequently have to make a round trip of more than 10 li to carry water. Genuine solution to the drinking water problem for people and livestock in these areas requires building of ponds to hold water in water-short communes and brigades so that within 3 to 5 years each village will have one or two ponds with a capacity of about 500 cubic meters of water. Then commune members in mountain regions will not have to drink water which has to be brought in from a distance, dirty water, or polluted water.

4. Need for Further Small-Scale Projects To Impound Water in Major Irrigation Districts

In the course of integrating irrigation projects and leveling the land, the number of small projects built to impound water should be increased and building of dammed ponds should not be stopped. These small projects can help in the regulation of irrigation by master projects.

3. Gradual Development of Comprehensive Control of Whole River Basins and Increased Construction of Projects for Control

Small water storage projects and large master reservoirs are mutually related and complementary. Without small-scale projects, master projects cannot play

their full role. Conversely, if there are only small-scale projects and no, or very few, powerful control projects as mainstays, it will be impossible to withstand large natural calamities.

The province's shortage over the long term of 16.4 billion cubic meters of water needed to achieve a balance between supply and demand obviously cannot be solved by small-scale projects; master projects will have to be built to assure supplies. Projects for basinwide control are very much able to do this in an overall way, and they provide multiple benefits for flood prevention, for electric power generation, and for navigation. They also play a tremendous role in the full development and use of water and soil resources within basins and in fundamentally improving conditions for agricultural production.

Take the Xi Shui Basin, which provides a rather good example for basin control throughout the province. Construction of the large Bailian He Reservoir in combination with the building of a water conservancy network consisting of small reservoirs at 85 sites within the basin has made possible the control of 1.35 billion cubic meters of water and control of a 2,004 square kilometer basin area, or more than 80 percent of both the total volume of water and the total basin area. This has not only guaranteed the water needs of 520,000 mu of cultivated land served by reservoirs in the lower reaches, but has also had a comprehensive effect. During the 14 years from construction of the Bailian He Reservoir and 1973, net volume of water entering the reservoir has totaled 15.25 billion cubic meters of which 1.7 billion cubic meters has been used for irrigation and 7 billion cubic meters used for the generation of electricity, a cumulative more than 700 million kilowatt hours of electricity having been produced. This has recovered investment in the reservoir, and given powerful support to use of electricity in agriculture required in the eastern Hubei mountain region. Benefits have also been marked in flood prevention. A torrential rain fell in the basin from 1 to 16 July 1969, but thanks to the reservoir's tremendous capacity for regulating water storage, the flood peak volume of flow was reduced by more than 3.5 times. Volume of water at Chengguan on the Xi Shui fell from that of massive floods such as occur once every 100 years to the size of floods that occur once every 10 years. Great losses of life and property for the 200,000 people of Chengguan and on both shores of the river downstream were avoided. In addition, the reservoir also blocked large amounts of silt so that the sand laden river bed downstream could be controlled and deepened. This helped navigation and transformation of fields below river level, and set the stage for harnessing the river and creating fields.

Master project control capabilities for the province as a whole (see Table 10-5) have developed unevenly from one prefecture to another. Huanggang Prefecture has the largest proportion with 43.3 percent of water control capacity. In Xianning Prefecture a fairly large area has been brought under control with the building of large power generating reservoirs at several sites on the Fu Shui and Lu Shui. However, looked at in terms of fighting drought and irrigation, the actual difference is still very great. In terms of both volume of water and proportional area controlled, Xiaogan and Xiangyang Prefectures have approximately equal capacity to withstand drought.

Table 10-5 Control Capacity of Master Reservoirs in Individual Prefectures of Hubei Province (as of 1976)

(a) 地区	(b) 面积 (平方公里)	区间径流总(c)量 (亿立方米)	(d) 大中型水库控制能力						
			处数(e) (处)	总(f)库容		(i)有效库容		(j)控制面积	
				库g容 (亿立米)	占来水(h)%	库g容 (亿立米)	占来水(h)%	面(b)积 (平方公里)	占总面积%(k)
Huanggang	20,268	101.4	44	39.93	43.3	25.37	25.0	4,457	22.0
Xiaogan	14,283.7	57.2	25	20.7	36.3	12.79	22.4	2,350	16.4
Xianning	15,014.5	105	26	40.37	38.4	18.8	17.9	7,019	46.6
Jingzhou	34,271	130	38	45.27	34.8	24.26	18.1	6,203	18.2
Xiangyang	26,452.7	100.5	64	36.7	36.5	22.37	22.3	7,147	27.0
Yunyang	22,124.6	77.5	7	1.12	1.44	0.69	0.89	1,139	5.1
Yichang	19,821	140	15	3.94	2.8	2.77	1.97	480	2.4
Enshi	24,951	224	1	0.18	0.05	0.13	0.05		
Other	10,221.5	64.4	12	0.74	1.2	0.53	0.82	248	0.9
Total	187,408	1,000.0	232	188.9	18.89	107.66	10.8	29,043	15.7

Note: "Yunyang" dam: does not include Huanglongtan; "other" dams: includes Wuhan City, Huangshi City, Shiyan City; and the Shennongjia forest area.

Key:

a. Prefecture
b. Area (10,000 sq kms)
c. Total runoff (100 million cubic meters)
d. Control capacity of large and medium size reservoirs
e. Number of sites
f. Total storage capacity
g. Storage capacity (100 million cubic meters)
h. Percent of incoming water
i. Effective storage capacity
j. Control area
k. Percent of total area

Table 10-6 Control Capacity of Principal Water Impounding Projects on Medium and Small Streams in Hubei Province

(a) 河名 \ (b) 项目	(c) 河长 (公里)	(d) 流域面积(平方公里)			(i) 年径流		其 (l) 中	
		(e) 总面积	其 (f) 中		径流深 (j) (毫米)	径流总量 (k) (亿立方米)	(m) 已控制	(h) 占总量%
			(g) 已控制	h占总面积(%)				
Xi Shui	165.6	2,504	2,004	80	615	15.3	13.6	82.8
Dao Shui	163	1,793	402.7	21.6	448	8.0	4.28	43.2
Ju Shui	170.4	4,054.6	1,368	33.3	483	19.6	10.7	55
Ba Shui	151	3,306	604	18.1	618	20.4	3.0	15.0
Che Shui	118	1,973	495	17.2	669	13.2	4.2	31.3
She Shui	112	2,172	(400)		420	9.1	5.24	58.0
Huai Shui	133	3,456	(686.4)		360	12.4	6.72	55.0
Yun Shui	266	12,866	(401.7)		276	35.5	(20.47)	57.7
Dafu Shui	149	1,554	415	26.2	359	5.58	1.66	28
Tianmen He	137	3,113	(566)	18.2	294	9.16	4.68	51
Lu Shui	192	3,943	3,400	86.2	776	30.6	16.55	54.0
Quan Shui	144	2,710	212	7.8	621.2	27.42	1.5	5.5
Fu Shui	180	5,310	2,847	53.7	848	41.6	23.4	56
Gun He	125	2,797	(1,270)		182.2	5.08	3.0	60.0
Man He	151	3,086	(1,362)	44	457	14.1	(5.0)	35.4
Du He	318	11,725	11,700	100	564	68.2	11.0	18.1
Nan He	235	6,343	2,301	36.3	396	25.1	2.5	10.0
Xiaoqing He	91	1,403	(886)	63.4		3.5	(2.2)	62.8
Bei He	125	1,215	(690)	56.8		3.22	1.82	56
Qing Jiang	427.3	16,770			851	142	2.0	1.4
Juzhang He	341.2	7,338	2,251	31.2	483	31.6	21.0	66.5
Huangbai He	152.5	1,894.8			695	9.84	1.0	10.0
Xiangqi He	93.5	3,099				21.6	0.03	

Note: Figures in parentheses are either wrong or statistics are incomplete

Key:

a. Name of river
b. Particulars
c. River length (kms)
d. Basin area (sq kms)
e. Total area
f. Including
g. Already controlled
h. Percentage of total area
i. Annual runoff
j. Depth of runoff (mm)
k. Total runoff (100 million cubic meters)
l. Including
m. Already controlled

The figures show that Jinzhou Prefecture is less able to withstand drought than the aforementioned prefectures; however, when the large plains lake areas are deducted, its control capabilities are greater than those if Xiaogan, Xiangyang and Xianning Prefectures. By comparison, the weakest link is still the western Hubei mountain region.

Looked at in terms of the more than 20 major streams in the province that flow directly into the Chang Jiang or the Han Jiang, the situation becomes clearer. These streams have a basin area that covers more than 60 percent of the province, and account for 65 percent of its water. They are the primary targets for future basin control. Their existing control capacity is vastly inferior to that of the Xi Shui Basin (see Table 10-6). Were the control capacity of these streams to reach existing levels in the Xi Shui Basin, the province's total control capacity would be greater than 50 million cubic meters of water, of which the effective volume would be no less than 30 billion cubic meters. Further integration with other small water storage projects and water diversion and water lifting capacity would make it possible to guarantee the whole province's long-term water needs, and the comprehensive development and harnessing of these river basins would bring huge benefits.

This shows that comprehensive control of the province's river basins will still be an exceptionally arduous task, and that the control capabilities of master projects in each jurisdiction must still be greatly improved. In this regard, the following is suggested:

(1) Use of standards for building farmland that produces consistently high yields, and reference to experiences in controlling the Xishui Basin to conduct further investigation and research on the province's main medium size and small streams. After bringing them under control preliminarily, programs as well as plans for their phased implementation should be worked up for each river basin in turn to prevent floods, to provide irrigation, to generate electric power, to permit navigation, and to dredge channels so as to attain and surpass existing levels in the Xi Shui Basin by the end of this century.

(2) Launching surveys and running pilot projects on movement of water from one basin to another. In addition to giving active consideration to plans for diversion of the Ju Shui into the Zhang He, the Xiaofu Shui into the Guishui, and the three water diversion schemes in Huanggang Prefecture (diversion of the Jin into the Guang, the Tianmen He into a lake, and diversion of the Hong into the Xin) plus carrying into effect completed plans, consideration should also be given to linking up various river basins in the central Hubei low mountain and hill region such as a link up among the large river systems of the Dao Shui, Jui Shui, Ba Shui, Xi Shui and Jin He. Looked at in terms of the province as a whole, the level of agricultural production in this area is high, and the double rice crop area large. A three crop system is developing rapidly, and large quantities of water are available. Though existing water conservancy rests on a good foundation, it is unable to fill needs. Topographically, all the streams originate in the foothills of the

Dabie and Tongbai mountains, most of them flowing from the northeast toward the southwest, and existing projects for impounding water are laid out along the trend of the terrain. As a result, it is possible both to connect them up along contour lines to the left and right, and to link them vertically with the lay of the land. This creates favorable conditions for the building of projects to move water from one basin to another. Were the province's rivers to be connected and the reservoirs linked, making it possible to move water from surplus to shortage areas, not only could needs for irrigation water be fully met, but flood waters would be basically confined to the mountains and stored in the mountains for all-around use.

(3) The northwestern Hubei mountain region is located along three lines, and requires water and electricity for national defense, industry and agriculture, as well as for the use of the civilian population. It has numerous streams and conditions for the building of reservoirs are more favorable than in southwestern Hubei. For this reason, the emphasis of water conservancy construction for the immediate future should be in northwestern Hubei. After completely integrating existing projects, further master projects should be built.

3. Upgrade Standards for Draining of Waterlogging to Cure Plains Lake Region Waterlogging and Drought Calamities at Their Source

Plains lake regions are the province's major commodity grain and cotton bases; they are also the focus of farmland capital construction. Following the principle of "take drainage as the key link in a combination of drainage and irrigation, a series of effective actions have been taken since liberation that have scored tremendous success. Nevertheless, present standards for raising water and drainage are still not high and ability to regulate the impounding of water in inland lakes has declined. The formation of a network of deep ditches and large ports has not kept up with requirements; control over the water table is weak; threat from waterlogging continues to exist, and a shortage of water for irrigation has gradually come about. Control at their source of waterlogging and drought calamities in plains lake regions to assure consistently high agricultural yields is an urgent task in farmland capital construction.

(1) Firm Grip on Major Contradictions To Upgrade Waterlogging Drainage Standards

The major contradiction in plains lake region agricultural production remains waterlogging calamities. For this reason, future water control requires continued adherence to the principle of "taking drainage as the key link in concurrent attention to drainage and irrigation and taking gravity drainage as the key link supplemented with electrically powered lifting of water for drainage, with comprehensive planning and all-around use." It requires active construction of some needed flood gates and large, medium and small-size electrically powered drainage and irrigation stations to drain stagnant water from easily waterlogged lowlands into rivers. This should be done in conjunction with the building of floodgate pumping stations, the dredging of rivers, creeks and lakes, and the digging of deep ditches and large canals

to separate rivers and lakes, lakes and fields, wetlands and drylands, and drainage and irrigation systems, to control the impounding of water in lakes, to lower water tables, to raise ground temperature, to increase soil fertility, and to strengthen capabilities to withstand waterlogging and drought in a fundamental improvement of plains lake region production conditions.

For the short run, standards for drainage of waterlogging should be to design engineering projects that will handle massive amounts of precipitation such as occur only once every 10 years (i.e., drainage within a period of 3 days of torrential rains that fall in plains lake regions at a rate of 186.1 millimeters per day). Before 1985, standards should be set to handle downpours such as occur only once every 20 years, each jurisdiction preparing designs on the basis of local data for torrential rains (see Table 10-7).

Table 10-7 Statistical Data on Torrential Rains for Some Plains Lake Regions

Units: millimeters

Station name	1 day of torrential rains			3 days of torrential rains		
	(a) 5% 二十年一遇	(b) 10% 十年一遇	(c) 20% 五年一遇	(a) 5% 二十年一遇	(b) 10% 十年一遇	(c) 20% 五年一遇
Hankou	261.3	217.5	171.2	330.1	274.3	216.3
Hanquan	284.7	237.9	191.2	333.9	279.0	224.2
Xinzhou	235.4	198.0	161.0	336.8	284.1	229.6
Jiayu	225.9	188.1	148.1	335.2	280.7	224.6
Honghu	223.7	190.4	155.9	288.8	245.8	201.2
Jianli	207.6	175.0	140.3	273.6	230.7	184.9
Shantao	190.7	163.6	135.2	249.7	214.1	177.4
Shishou	230.7	192.5	154.2	285.2	238.0	190.7
Yangxin	220.1	183.0	143.0	294.1	244.6	192.3
Pingjun	221.8	186.1	150.0	291.8	248.0	207.5

Key:
a. 5 percent. Once in 20 years
b. 10 percent. Once in 10 years
c. 20 percent. Once in 5 years

(2) Increased Construction of Needed Master Electric Drainage Stations and Increase in Installed Capacity Simultaneous With Improvement in Capabilities To Regulate Storage of Water in Rivers, Lakes, Ravines and Canals

In order to solve the problem of plains lake area waterlogging, Hubei Province has built large numbers of floodgates along rivers since liberation, so a certain basis for gravity drainage exists. However, during flood stage in many years, the water level in rivers outside the gates is higher than the

water inside the gates, so gravity drainage will not work, and a large area becomes waterlogged. Therefore, until such time as the Chang Jiang and the Han Shui have been brought under full control, it will be necessary to rely on pumping equipment to lift the water during the 4 to 6 month high water period in the vast lake region as the only way of removing stagnant water from farmland promptly. Fixed electrically powered pumping stations have a series of advantages over the mechanical lifting of water, and thus have seen rapid development during the past 10 years or so. As of the end of 1978, the province had built pumping stations with an installed capacity of 628,300 kilowatts, which have shown tremendous power in the prompt drainage of stagnant water from the surface of the land. However, most of these pumping stations have been designed to handle a situation such as occurs only once each 10 years. Furthermore, some of them are redundant, and some require further equipment. Additionally, another 4 to 5 million mu of farmland lacks water lifting equipment. In order to increase plains lake region capabilities to drain waterlogging, more electric pumping stations will have to be built. For example large pumping stations at Fankou, Luoshan, Qingjiangkou, Fenshuizui, Donghu and Xintankou will have to be made part of the plan in order to solve the problem of large area waterlogging at places such as Liangzihu and Sihu. Inasmuch as electric drainage stations require large investment, consume much electricity, concentrate use of power during peak periods, and have a low annual utilization rate, reasonable limits must be set for long range installation of machinery in electric pumping stations. The following average values have been ascertained after overall consideration of plains lake regions:

(1) Drainage area figured at 28,000 square kilometers for the whole lake area;

(2) Standard for drainage of waterlogging figured at 300 millimeters of rainfall per day and a corresponding 210 millimeter runoff (long-range plan);

(3) Regulation of river and lake storage figured at 12-15 percent (following retreat of water from fields to return to lakes and control of the lake surface). Adjusted depth of storage figured at 0-1 meter, converted to a surface water depth of about 120 millimeters;

(4) Not counting regulation of storage, but complete drainage within 3 days, the volume of water lifted and drained each day =

$$\frac{210-120}{3} = 30 \text{ millimeters.}$$

Using this standard, an average installed capacity of more than 30 kilowatts per square kilometer will be required. There is a certain slippage between this estimate and reality. However, by building only high standard, deep ditches and ports, and regulating storage in lakes, the two being able to control more than 50 to 60 percent of storage, it would be possible to meet high standard drainage requirements for fields that produce consistently high yields without an overly high installed capacity. About again as much as present installed capacity would be required, i.e. 1 to 1.2 million kilowatts would substantially meet requirements.

(3) Digging of Deep Ditches and Large Canals To Drain Stagnant Surface and Ground Water

After gravity and water-lifting projects have solved the problem of wide area inland lake water stagnation and water stagnation in plains lake areas, it will still be necessary to have a deep ditch and a large canal system to divert the stagnant water into rivers if consistently high yields from farmlands are to be insured.

Not only do deep ditches and large canals play a role in draining away stagnant surface and underground water, but they also regulate runoff to the benefit of navigation, breeding of aquatic products and irrigation. The 28,000 square kilometer Jianghan Plain lake region generates a surface water runoff totaling about 6 billion cubic meters. If a daily rainfall of 300 millimeters is to be drained away within 3 days, only coordinated use of river network and lake storage and mechanical drainage of water will succeed.

River network control of the water surface and the amount of water impounded bears directly on the size of deep ditches and large ports. Currently some communes are able to control about 4-6.9 percent of the river network water storage area using low standards. Regulation of water storage at between 20,000 and 70,000 cubic meters per square kilometer controls runoff to a depth of between 20 and 71 millimeters. In order to drain away a rainfall of 300 millimeters per day, a river network's capacity to regulate storage would have to be increased commensurately. In light of the 15 percent standard put forward by Hunan and Jiangsu Provinces as the total river and lake storage area, within counties and communes deep ditch and large port areas that are 7 to 10 percent of total area would be suitable. If lake storage can be regulated, the river network area may be somewhat reduced. Without lake regulation of storage, the river network area would have to be somewhat larger. If the terrain is higher and the water table relatively lower, the river network may be somewhat less extensive and smaller in cross section. Conversely, it would have to be denser and larger in cross section.

Using the foregoing water surface area for calculations, and supposing deep ditches and large ports to regulate water at an average 1 meter depth, on average each regulation of stored volume would be between 70,000 and 100,000 cubic meters per square kilometer, with corresponding control of runoff to a depth of between 70 and 100 millimeters.

Experience in various jurisdictions inside and outside the province with levels of river networks shows that a layout of high standard river networks with four to five levels in counties and communes is about right, the ditches and ports at the second and third levels being designed according to the size of the area to be controlled. For the final two levels of river networks, since the lay of the land within a commune or brigade varies but little, one should do whatever is required for a high standard terraced river network, which can be gradually unified. Since the final level of river networks enters fields directly and functions to drain away stagnant water on the surface and to control ground water level, the depth to which the final level is dug should be decided on the basis of the depth of water crops will tolerate.

Since it is necessary to control the water table at below 1 meter for most crops, ditch depths should be no less than 1.5 meters (see Table 10-8). The distance between ditches should vary with soil porosity and with ditch depth. Experiments conducted in Jiayu, Jianli and Mianyang Counties show that when ditches are 1.5 meters deep, they affect the water table over a 50 meter radius; thus ditches should be 100 meters apart.

Table 10-8 Minimum Ground Water Depth (Meters) Required by Various Major Crops

Crop	Cotton	Wheat	Green manure	Rice	Vegetables
Water table depth	1-1.4	0.6-0.8	0.5-0.8	0.5	0.8-1.0

To summarize the foregoing, by so-called high standard deep ditches and large ports, and field terracing of river networks requires that within counties and communes river networks be laid out at four or five levels to the fields. The ditch water holding area should be 7 to 10 percent of local area; the volume of water moved to storage should average between 70,000 and 100,000 cubic meters per square kilometer; and runoff to a depth of 70 to 100 millimeters should be controlled. Within communes and brigades, the river network should average 6 to 7 kilometers in length per square kilometer. This is consistent with regulating lake storage, electromechanical drainage and controlling the water table below 1 meter, i.e., it is capable of handling a torrential rainfall of 300 millimeters to assure a bumper harvest.

Additionally, experiments may also be conducted for drainage into wells so as to explore what is involved and to accumulate experiences.

(4) Separation of Drainage and Irrigation Networks and Development of Water Resources To Solve Plains Lake Region Needs for Irrigation Water

With expansion of the double cropped rice area in plains lake regions in recent years, irrigation water for fields is needed early, and amounts needed have steadily increased. However, during April and May each year, the water level in rivers flowing into such regions is often below the level of the surrounding land making it difficult to divert water for irrigation. In addition, in order to make room for the storage of stagnant water, lake waters have to be drained to the lowest level in advance of the high water season. As a result, with the advent of each spring drought, the conflict between irrigation and drainage becomes exceptionally prominent, and the effects on agricultural production are very great. One way of solving spring drought irrigation problems in plains lake regions is to control the amount of water lakes can hold by using dredges to deepen lakes and dig deep ditches and large canals to increase the volume of water impounded. Another way is to link drainage and irrigation at the time when large and medium size electric drainage stations are being planned and designed so that a single station will serve multiple functions, i.e., to lift and drain lake waters into

irrigation ditches and use the water to irrigate farmlands. A third way where water resources and the lay of the land permits is to build some water diversion floodgates in the establishment of drainage and irrigation systems so that water will be available for irrigation and so that drainage will have someplace to go. This would be separate gravity-fed irrigation and drainage systems laid out at different levels. For example, consideration should be given to building floodgates at Shashi to divert a 500 to 600 cubic meter flow for the irrigation of more than 5 million mu of farmland in Jingbei Prefecture. This would additionally supplement water resources for counties lying on the south bank of the Han Jiang and expand farmland irrigation by 8.5 million mu. A fourth way would be to develop well irrigation to a certain extent so long as flood prevention was handled first. This would also be a way to solve irrigation problems in lake regions by balancing supplies against demand.

Third Section. First Land Soil Improvement and Improvement of Terraced Slopes

Soil is the basis for agriculture; "if there is soil, there is grain." But unless the soil is looked after and waters controlled, this potential cannot be very well developed. As the masses say, "To harness water without improving soil means having water with no place to use it; to improve the soil without harnessing water means coming to grief when drought or waterlogging strikes." This is the dialectic relationship between soil improvement and harnessing of water.

1. The Soil Improvement Task

The main job in soil improvement is leveling of the land and the terracing of slopes to create a minitopography and a cultivated soil layer that will conserve water, soil and fertilizer to make possible the growing of crops and achieve the goal of consistently high yields.

Right now the province still has more than 33.4 million mu of cultivated land (see Table 10-9) where erosion is occurring, or that cannot be irrigated or drained, or that is infertile and not very farmable from which yields are not high. Were this cultivated land to be improved to increase grain yields by between an average 100 and 200 jin per mu, the province's grain output would rise by from 3.5 to 7 billion jin. As agriculture develops, the need to level the land and improve the soil increases. In order to obtain grain yields of 2,000 jin per mu, some fraternal provinces and regions have proposed plans for building "double goal fields," and "ton of grain fields." In Hubei Province, some advanced units such as the Shiyue Brigade and the Qianjin Brigade in Xishui County, the Bayi Brigade in Suixian County and the Xuguang Brigade in Echeng County already produce grain yields which average close to or more than 1 ton per mu. An even large number of counties have cotton crop yields that reach or surpass the "double goal." Yunmeng County, for example had 18 production brigades that produced 200 jin per mu of cotton. In future farmland capital construction, the need to level the land and improve soil will become more pressing, and standards in building farmlands that produce consistently high yields will become increasingly high. This is an objective imperative in development of farmland capital construction that must be fully calculated.

In achieving the goal of 1 mu of farmland per capita of agricultural population that provides consistently high yields and from which a crop can be harvested despite drought or waterlogging, Hubei Province can take two steps as follows: In 1980, the province achieved 1 mu per capita of farmland from which a crop could be harvested despite waterlogging or drought, and 60 percent or about 25 million mu of the province's 41 million mu produce consistently high yields. The second step is to achieve, over the next 5 years, a 42 million mu area in the province that produces consistently high yields, with 1 mu of farmland per capita producing a harvest despite drought or waterlogging.

Table 10-9 Statistics on Soil Improvement in Hubei Province

Units: 10,000 mu

(a)地、市	(b)坡耕地改造		(c)大平小不平		(d)低产田面积		(e)水土流失面积	
	原(f)有	已(g)改梯	原(f)有	已(h)平整	原(f)有	已(h)改造	原(f)有	已(i)治理
Province as a whole	1,163.41	529.28	3,141.0	1,309.97	1,640.61	763.41	7,868.34	4,420.79
Huanggang	105.62	65.68	337.84	125.27	204.42	124.27	1,210.55	810.69
Xiaogan	73.1	42.01	309.0	63.3	147.18	71.54	412.45	272.37
Xianning	56.33	20.12	201.14	93.57	126.02	52.7	345.71	174.48
Jingzhou	82.53	33.91	1,039.52	324.47	722.24	321.49	287.5	249.6
Xiangyang	78.0	36.3	760.46	462.0	111.86	71.66	524.1	187.9
Yunyang	240.96	98.75	108.71	58.79	46.04	18.41	2,156.03	1,038.04
Yichang	169.3	96.35	164.8	84.66	101.78	52.65	1,120.03	700.98
Enshi	300.6	93.65	54.34	41.16	85.47	9.78	1,579.5	844.67
Shiyan	4.25	1.46	1.5	0.65	2.59	0.94	117.3	79.91
Huangshi	5.1	1.65	54.32	17.36	17.2	8.96	19.72	13.42
Wuhan	47.62	24.55	109.82	38.74	75.81	27.55	95.45	48.72

Key:
a. Prefecture or city
b. Improved cultivated slopes
c. Largely leveled
d. Low yield field area
e. Eroded area
f. Former
g. Terraced
h. Leveled
i. Brought under control

2. Estimating the Size of the Task

Estimating the size of the farmland construction task necessary to produce consistently high yields bears on the issue of construction standards, to be sure. In its planning to develop agriculture, standards that the province applies to capital construction of farmland are "a level surface, carefully laid out plots, a thick cultivated layer, fertile soil, a combination of woodlands and roads, building of canal systems, ability to drain and to irrigate, ability to impound or release water, intensive farming, and consistently high yields." Using these requirements as a yardstick, we conducted a representative sampling of the number of projects for improving the land in some communes and brigades in plains lake regions, hill regions and mountain retions. Our initial conclusions were as follows: The average amount of soil that has to be improved in order to build a single mu of farmland that produces consistently high yields and that will produce a crop despite drought or waterlogging is 200 cubic meters in plains lake regions,

400 cubic meters in hill regions, and 600 cubic meters in mountain regions. Extrapolating from these figures, a total of 13 billion cubic meters of soil of the province's 33.42 million mu of cultivated land requiring control will have to be improved. This figure is equal to the sum of all farmland capital construction in the province from 1949 to 1978.

3. Several Recommendations

The task of leveling the land and improving the soil is a basic one in large-scale agriculture and a fundamental task of far reaching significance in the building of modern agriculture.

(1) In centering efforts toward the objective of having 1 mu of farmland that produces consistently high yields and from which a crop can be harvested despite drought or waterlogging, each prefecture, county, commune and brigade will have to work up soil improvement plans, set short-term and long-term tasks, and go about bringing parcels of soil under control over a period of time in a planned, step-by-step manner. The experiences of Badong, Jianshi, Baokang, Huanggang, Yingshan and Jiayu Counties in large-scale soil improvement, in terracing of mountain slopes, in strip farming of flatland in mountainous areas, of making garden plots on rolling land, and of building upraised fields in lake regions should be emulated to hasten control.

(2) Under present circumstances in which the leveling of land is done by hand, priorities have to be assigned to soil improvement, the most promising land improved first with the rest remaining till later. In laying plans, following the principle of more, faster, better and more economical, gentle slopes should be improved first, steep slopes coming later. Land having good water should be improved first, land with less favorable water resources coming later. Land with thick topsoil should be improved first and land with thin topsoil later. Land in continuous tracts should be improved first, dispersed fields coming later. Land having a large potential for increased yields should be improved first, land with small potential waiting till later.

In mountain regions, the terracing of hillsides should be paramount. Plans should be made for the terracing of a certain amount of slopes annually. In Enshi and Yunyang Prefectures, some counties assigned communes the task of terracing 1/10 mu per person per year, the work to be completed on time and inspected for acceptance. This method merits adoption elsewhere. Cultivated slopes with a grade of more than 25 degrees should gradually be withdrawn from cultivation and returned to woodlands.

Once a supply of water can be assured, drylands in hill and upland areas may be leveled for conversion to wetlands in active expansion of wetlands or irrigated areas.

Plains lake regions should combine deep ditches and large canals with the laying out of irrigation and drainage systems and the building of garden style fields. They should improve the soil, level the land little by little, lay out rectangular fields, equip them with ditches and upraised pathways and plant trees for shade.

(3) Promotion of spray irrigation techniques. Spray irrigation is neither affected by topography nor limited by the grade of slopes. It also conserves water and may be used flexibly where required. Use of spray irrigation on gentle slopes that "depend on the heavens for a harvest" where the soil layer is fairly thick can assure consistent yields. At the present time, emphasis in the development of spray irrigation should be placed on areas that are dry and lacking water where yields are inconsistent, and where the task of improving the soil is an arduous one. Additionally, some cash crop growing areas and areas in which the growing of vegetables is concentrated should also actively develop spray irrigation.

(4) With steady agricultural modernization, mechanized operations should gradually replace the strenuous physical labor required for soil improvement projects. Whenever specialized teams are formed for farmland capital construction, they should be equippped with needed construction machines little by little and in a planned way so as to increase labor efficiency and hasten construction.

Fourth Section. Active Development of Small-Scale Rural Hydroelectric Power

Hubei Province has plentiful water power resources and superior conditions for development of small-scale rural hydropower. Development of small-scale rural hydropower holds major significance for changing the pattern of fuel use for power, for solving the shortage of electric power for local industries, for promoting development of commune and brigade enterprises, for solving the surplus rural labor problem, and for transfiguring mountain regions. During the past 3 years, small-scale rural hydropower has gone from the previous 120,000 kilowatts to 300,000 kilowatts with ever-increasing speed. In 1978 alone, a 120,000 kilowatts increase took place. Today the province has 59 counties that use hydropower that they have generated themselves, and 9 of these counties have an installed capacity of more than 10,000 kilowatts. Farm machinery, water conservancy and chemical fertilizer industry as well as commune and brigade enterprise use of electricity has burgeoned. For example, now that the Jianshi County Chemical Fertilizer Plant has the county's small hydropower plant to rely on, it annually produces 20,000 tons of chemical fertilizer, and the county fertilizes at the rate of more than 60 jin per mu of cultivated land. This has given powerful impetus to development of agriculture.

However, the building of small-scale rural hydropower started slowly in the province and, in an overall sense, it has not developed very rapidly.

In addition to the Chang Jiang and the Han Jiang, there are more than 20 major tributaries and more than 1,000 small streams capable of generating about 6 million kilowatts, including 4,073,000 kilowatts from already identified stepped terraces. An installed capacity of 538,00 kilowatts has already been developed, but this is only 13.2 percent of the potential (see Table 10-10).

In order to further hasten development of the province's hydropower endeavors, water control and the generation of electric power should be linked in future farmland capital construction for all-around use. Harnessing of water should provide more water, grain, electric power, fertilizer and fish. By 1985, the province's 27 major streams should be comprehensively developed, with efforts made to develop 10 streams including the Xi Shui, Fu Shui, Lu Shui, Yuyang He, Huangbai He, Daoshui, Man He, Wei Shui, Cheba He and Yesan He from their upper reaches to their mouths into a series of connected steps for all-around benefits. Each county should be required to have a small electric power plant and where large power lines do not reach into the mountains, small power units should hook up to the grid, with any surplus being sent elsewhere. By 1985, installed capacity of small-scale hydropower should be between 1.2 and 1.5 million kilowatts. Then an additional 120,000 to 180,000 kilowatts should be added annually thereafter, the number of counties in the province generating 10,000 kilowatts reaching 57.

Since small-scale hydropower requires great investment and much equipment and materials, in view of present shortages, it will be necessary to set

Table 10-10 Status of Development of Hydroelectric Power on Major Streams in Hubei Province

Stream	Runoff area (sq km)	Counties traversed	水(a)力蕴藏量(万千瓦)	到1978年已装机(万千瓦)	←(b) Percent
Total	103,058	54	407.30	53.8	13.2
Dao Shui	1,864	Hongan, Xinzhou	1.1	0.34	31.0
Ju Shui	4,120	Macheng, Huanggang, Xinzhou	4.0	1.91	47.7
Ba He	3,331	Macheng, Huanggang, Luotian	5.51	1.81	32.8
Xi Shui	2,501	Yingshan, Xishui	9.58	6.4	66.5
Che He	2,820	Jinchun, Xishui	2.71	1.01	37.5
Fu He	8,321	Suixian, Anlu, Yunmeng, Xiaogan	2.64	0.14	5.3
Huai Shui	3,458	Yingshan, Dawu, Xiaogan	1.3	0.93	71.5
Dafu Shui	1,554	Jingshan, Yingcheng	5.51	0.52	9.5
Wei Shui	1,691	Wufeng, Songzi, Gongan	4.48	1.45	32.4
Lu Shui	3,943	Tongcheng, Chongyang, Puche	10.1	6.45	64.0
Fu Shui	4,904	Tongshan, Yangxin	11.26	4.37	39.0
Quan Shui	1,400	Tongshan, Xianning	2.17	0.49	22.6
Qing Jiang	16,742	利川、恩施、宣恩、建始、巴东、五峰、长阳、宜都 (c)	171.2	3.64	2.1
Huangbai He	2,038	Yuanan, Yichang	7.55	1.58	20.9
Yuyang He	1,181	Wufeng, Yidu	6.48	0.66	10.3
Xiangqi He	3,027	Xingshan, Zigui	5.05	0.49	9.8
Ju He	3,412	Nanzhang, Yuanan, Dangyang	12.97	0.8	6.2
Zhang He	2,357	Nanzhang, Yuanan, Jingmen, Dangyang	6.21	0.75	12.0
Yandu He	1,000	Badong	7.31	0.42	0.57
Qian Jiang	2,303	Xianfeng	13.9	0.42	3.0
Xi Shui	1,410	Laifeng	15.07	0.49	3.2
Du He	10,813	Fangxian, Zhushan, Zhuqi, Yunyang	62.01	16.32	26.1
Nan He	6,342	Fangxian, Baokang, Gucheng	19.65	0.92	4.7
Man He	3,345	Nanzhang, Yicheng	3.73	1.28	34.2
Tian He	1,614	Yunxi	1.23	0.21	17.0
Jia He	5,600	Yunxi	11.64	—	—
Tao He	1,669	Yunxian	2.94	—	—

Note: Water power reserves: Theoretically developable water power reserves of more than 6 million kilowatts. Machinery installed: includes machinery installed in power stations on the Huanglong, Lu Shui, Bailian and Fu Shui.

Key: a. Hydropower reserves (10,000 kw)
b. Installed capacity as of 1978 "
c. Lichuan, Enshi, Xuanen, Jianshi, Badong, Wufeng, Changyang, Yidu

priorities, with arrangements being made first to equip power stations that have been built but lack machinery and water conservancy hub projects. Old Soviet areas, three line areas, and remote mountain areas should hasten the building of hydropower.

The southwestern Hubei mountain region is known as a "hydropower warehouse." In 15 counties in this region, the Qing Jiang, Huangbai He, Xiangqi He, Juzhang He, Yandu He, Qian Shui, Xi Shui and Yu Jiang have reserves totaling about 3 million kilowatts, which is half the province's reserves. However, only 10 percent of this has been developed so far. This must become a major area for future development. In addition to the planned development of steps from Changbian on the main stream of the Qing Jiang, planning and design work for steps on 11 tributaries of the Qing Jiang and on other streams should be organized within the province, actual prospecting and planning done, and tasks assigned for rapid development of southwestern Hubei hydropower endeavors.

Chapter 11. Hasten the Pace of Agricultural Mechanization

Agricultural mechanization is a major integral part of agricultural modernization, and it is also an urgent desire and demand of the broad masses of peasants. The province's rural cadres have an extraordinarily profound understanding based on personal experience of Comrade Mao Zedong's dictum that, "The fundamental way out for agriculture lies in mechanization." It is with a fuller revolutionary zeal and strengthened confidence that they have responded to the call of the CPC Central Committee to hasten the pace of agricultural mechanization and have plunged into the struggle for high speed development of socialist agriculture for early modernization of agriculture.

Here some preliminary ideas and views will be floated on several major problems in Hubei Province's agricultural mechanization.

First Section. Major Orientation and Near Term Needs for Agricultural Mechanization Throughout the Province

In terms of the province as a whole, for some time to come, the focus of agricultural mechanization will have to be primarily in the four areas of plowing and soil preparation, drainage and irrigation, agricultural transportation and harvesting. An upturn in these four basic operations to which a substantial amount of labor is devoted will not only help win the race against time in farming seasons, increase grain and cotton output, and greatly ameliorate labor shortages during busy seasons, but will also promote all-around mechanization and give impetus to development of economic diversification and commune and brigade enterprises. Simultaneously, serious attention must be directed to mechanization of the transplanting of rice seedlings, cultivation of cotton fields, threshing and drying of grain, plant protection, farmland capital construction work, production of special local products, and processing, as well as to mechanization of forestry, animal husbandry, sideline occupations and the fishing industry.

Machine transplanting of paddy rice and machine cultivation of cotton fields should be actively promoted and gradually spread, first in places where fields are large relative to the labor force. In the threshing of grain, powered threshing machines should gradually replace the currently widely used removal of husks with millstones. Drying of grain should be carried out first in principal grain producing areas where energy conditions permit. In plant protection work, machine spraying apparatus should gradually replace spraying devices carried on the back that are widely used at the present time. Priority should go to solution of mountain region problems in capital construction of farmlands and in production of major special local products. In forestry, animal husbandry, sideline occupations and fisheries, mechanization should be developed to prepare land for afforestation, to tend and fell trees, to transport timber, to harvest fodder grass and process livestock feed, to dig ditches, to drain and irrigate land and to catch aquatic products.

With effort, the mechanization of agriculture should reach the following level by 1985: Plowing and soil preparation, drainage and irrigation, farm transportation, plant protection, threshing and processing should be about 80 percent mechanized or semimechanized. Mechanization of grain harvesting should have reached a fairly high level in major grain growing areas. Mechanization of grain drying, transplanting of rice seedlings, and cotton field cultivation should be fairly far along in some places. Mechanization or semimechanization of farmland capital construction work, and production and processing of principal local specialty products as well as of forestry, animal husbandry, sideline occupations and the fishing industry should see considerable increase and a group of fairly highly mechanized forestry, animal husbandry and fishing industry production bases will have been built. Most major operations on state-owned farms and suburban agricultural production will have been substantially mechanized and a group of production bases with varying degrees of mechanization will have been built for the raising of hogs, chickens and cattle. Everywhere in the province there will be counties, communes and

production brigades that have been substantially mechanized and in which both labor productivity rates and marketable goods rates will have increased tremendously and that are developing in the direction of specialized production.

Since agricultural production levels and economic levels vary from one place to another, priorities for agricultural mechanization must be set. From now on, in addition to continuing to run well the Xinzhou national agricultural mechanization test project, first priority should go to greater mechanization of commodity grain and cotton bases in the Jianghan Plain region, the central Hubei hill region, and the northern Hubei uplands. Naturally, by priorities is meant a combination of key sites and entire areas. Key sites should develop somewhat more rapidly than entire areas; however, entire areas should also adapt general methods to their specific circumstances to set their own direction of attack, and they should also have their own individual sites that move ahead. In this way, the whole province's agricultural mechanization will be able to move ahead steadily, with key sites spearheading the way in development of both key and entire areas.

Second Section. Focus of Regional Development and Providing Farm Machines

Inasmuch as terrain, landforms and quality of soil vary from place to place, crops also differ and the farming system and agricultural techniques differ too. How to decide individual directions of attack on the basis of specific circumstances and equitably equip various areas with the farm machines and implements that meet their local circumstances, is a major problem requiring constant study for solution. On the basis of current, preliminary understanding of some circumstances, and in view of farm machinery suitability, the whole province may be divided into four basic kinds of areas for development of farm machinery, namely, plains lake regions, uplands, low mountains and hills, and mountain regions. (For particulars on amounts of farm machinery owned by each of the province's regions, please see Table 11-1.)

Table 11-1 Amounts of Farm Machinery Held by Various Regions in the Province (1978)

	农用总动力 (a) (马力)	每马力负担耕地面积 (b) (亩)	(c)拖拉(b)机 (d)总马力	(c)拖拉(b)机 每马力负担耕地面积(亩)	机耕面积 (e) (万亩)	占耕地 (f) 面积%
全 (g) 省	7,766,544	7.3	1,748,796	32.43	1,889	33.28
(h) 江汉平原	4,082,148	6.9	881,391	28.23	986.97	39.67
(i) 鄂北岗地	434,672.4	10.09	91,729	47.83	196.3	44.74
(j) 鄂东北 (k) 鄂中 (l) 鄂东南	1,874,105	7.58	459,772	30.9	451.7	31.8
鄂(m) 西南 鄂(n) 西北	972,046.5	13.53	176,009	74.71	131.8	10.02

Note: State-owned farms are not included in the regions of this chart; thus, numbers for the whole province are greater than the total for the regions.

Key:

a. Total power used in agriculture (horsepower)
b. Cultivated land area per unit of horsepower (mu)
c. Tractors
d. Total horsepower
e. Machine cultivated area (10,000 mu)
f. Percentage of total cultivated land
g. Whole province
h. Jianghan Plain
i. Northern Hubei uplands
j. Northeastern Hubei
k. Central Hubei
l. Southeastern Hubei
m. Southwestern Hubei
n. Northwestern Hubei

1. Plains Lake Region

The plains lake region means the Jianghan Plain. Here the land is broad and flat; cultivated land lies in large tracts; and individual fields are large, all of which is very favorable for agricultural mechanization. Here both total farm machine power and the amount of cultivated land farmed per tractor horsepower is higher than the provincial average. With the future spread of farm machines, this region will remain a key one to be equipped with farm machines. Main problems to be tackled are machine tillage, drainage and irrigation, farm transportation and harvesting, as well as the drying of grain, cultivation of cotton fields and transplanting of paddy rice.

(1) Spread of Machine Plowing

In 1978, the proportion of the Jianghan Plain farmed by machinery was greater than the provincial average and problems in machine preparation of the soil had been substantially solved. Nevertheless, a large amount of land was still plowed by oxen and then prepared by machines, so both people and plow oxen still carried quite a burden.

In the future, in places where mostly rice is grown, there will have to be continued investment in mostly medium size and small tractors while, at the same time, efforts will have to be made to develop machine plowing boats and power boats. With such mechanized equipment available, the problem of machine plowing will not be difficult to solve. Particularly since machine plowing boats and power boats have already been in use in this region for many years and are valued by the masses, a definite foundation for their use exists. In 1978, the province had a total of 24,000 machine plowing boats, 81 percent of which were located on the Jianghan Plain. In recent years, the area plowed and prepared by machines in Jianli and Mianyang Counties has grown very rapidly. Machine preparation of the soil is already being done on 70 and 80 percent respectively of the wetlands area of these two counties, and in more than 60 percent of these instances, machine power boats and power boats are used. In major cotton growing areas, the main machines to be provided should be mostly large and medium size tractors for large upland tracts. These would be suitable both for large area plowing, harrowing, sowing and hauling, and could also go into cotton fields to cultivate. They could also be used in multiple ways. A particular point to be made here is the need to take a firm grip on mechanization of cotton field cultivation. This is a key measure required to solve the labor shortage in cotton growing areas and inability to do all the work required in each farming season.

(2) Improvement of Machine Drainage and Irrigation Capabilities

In order to solve the problem in plains lake regions of "high water and low fields" that are prone to waterlogging and water stagnation, in addition to keeping a firm grip on farmland capital construction, efforts will have to be made to increase machine drainage and irrigation capacity, to develop stationary sump pumps, and to install a certain number of large horsepower diesel engines and large pumps and pipes that are a part of large water conservancy projects. The goal should be the gradual increase in drainage and

irrigation capacity to handle major waterlogging and withstand major drought. In addition, spray irrigation of drylands should be actively developed.

(3) Increase in Hauling Machinery

The Jianghan Plain is a commodity grain and cotton production base where the amount of agricultural hauling is particularly large. Surveys show that between 40 and 50 percent of all agricultural labor is engaged in hauling. Road conditions here are better than elsewhere, canals are deep, ports are large, and streams numerous. There should be continued increase in the number of rubber-tired vehicles, single-wheeled vehicles, wooden ships and mechanized junks, and provision of a certain number of trucks for farm use, plus tractors. There should be simultaneous mechanization and semimechanization, simultaneous water transportation and land transportation and rapid increase in the extent of mechanization of agricultural transportation.

(4) Active Development of Harvesting Machines and Emphasis on Step-by-Step Promotion of Transplanting Machines

In plains lake regions and particularly in each of the counties of Jingzhou Prefecture, each member of the workforce is responsible for a large area of cultivated land that requires a long time to transplant and harvest. Early rice, intermediate rice and late rice require several months of continuous work. Harvesting machines and windrow mowers should be actively developed. At the present time, windrow mowers can be used only on intermediate and late rice; problems in machine cutting of sodden early rice have yet to be solved. Promotion of transplanting machines should center on places where fields are large relative to the available workforce. They should be tried out on a group of fields, come to be used permanently on a group of fields, and be developed on a group of fields in a step-by-step improvement process. Grain drying should be tried out, first of all in major grain growing areas where energy is fairly available, and then gradually promoted elsewhere.

2. Uplands

By uplands is meant the northern Hubei uplands agricultural region, largely the northern parts of Xiangyang, Guanghua and Zaoyang Counties (termed "three norths" for short). This is a commodity grain and cotton base that is being built in Hubei Province in which there is much land relative to the labor force; farming methods are extensive, yields per mu low and potential great. It is urgently in need of farm machines. For this reason, this region should be a key one in the province's agricultural mechanization. Plowing, drainage and irrigation, and farmland capital construction should be mechanized, and a good job done of providing machines, providing associated equipment and using it in these several major production links.

(1) Equipping With Large and Medium Size Tractors

In the "three norths" region, the flat upland area is fairly large and the hilly upland area small; however, in most places the soil is yellow soil, which is clayey and leathery. In view of the nature of the soil, the region

should be equipped with large and medium size tractors for the most part. The soil here is not easily plowed, and the period during which it may be plowed is fairly short, so rush efforts must be made to complete plowing, harrowing and sowing, the three tasks being completed as part of a single process within a fairly short period of time. For this reason, each tractor should be equipped, at minimum, with a plow, a harrow, a seed drill and a trailer, and suitable farm implements should also be provided to meet agricultural production needs here.

(2) Development of Machine Lifting of Water for Irrigation

At the present time less than 60 percent of cultivated land in the entire uplands area can be irrigated. Providing sufficient sources of irrigation water entails not only continued building of reservoirs, dammed ponds and large pump irrigation stations, but also use of mechanical equipment for lifting water. This includes equipping pump wells with power machines, pumps and pipes. It also entails gradual provision of high horsepower diesel engines and associated pumps and pipes for dead spots in high upland regions not reached by water conservancy projects. More than 1,700 of the more than 4,800 pump wells in the northern Hubei upland region have not been fitted out. This should be done as soon as possible to obtain early benefits from these pump wells.

(3) Equipment With Bulldozers and Earth Scrapers

The task of soil improvement in the northern Hubei upland region is a very large one. When equipping the region with large and medium size tractors, in addition to providing complete farming implements, a certain number of bulldozers and earth scrapers should also be provided for farmland capital construction work. Though a basic amount of caterpillar tractor bulldozers have been provided, the number is very small, and the number that can be provided in future will also be very limited. Therefore, urgent study should be devoted to importing and improving bulldozing attachments for wheeled tractors.

Greater attention should also be given to development of farm hauling machines, harvesters and grain drying machines, and to the promotion in principal growing areas of cotton field cultivators and rice seedling transplanters. Special efforts should be made to increse the machinery used for hauling, harvesting and drying.

3. Low Mountains and Hills

The low mountain and hill region includes the three farming regions of northeastern Hubei, southeastern Hubei, and central Hubei where mostly wetlands are farmed. In addition to producing grain, cotton and edible oils, a fair proportion of these areas is devoted to the growing of cash crops. Further mechanization of agriculture in these places should emphasize mostly machines for plowing and preparing the soil, for drainage and irrigation, for farm hauling, and for farmland capital construction, and production and processing of special local products should also be gradually mechanized.

(1) Mostly Medium Size and Small Tractors as Farm Equipment

In low mountain and hill regions, in addition to a fairly large area of flatland tracts, there are small continuous tracts of 10 to 100-odd mu in area. Machine operations are very much ill-suited to low mountain and narrow valley cultivated land areas where plots are small, terraced fields are numerous, and where relative heights differ by from 0.3 to more than 0.6 meters. For these reasons, farm equipment should be medium and small tractors, for the most part. In addition, standards for farmland capital construction should be raised, the land leveled and soil improved, and roads for machine plowing built to provide the conditions required for machine operations.

(2) Improvement in Mechanization and Semimechanization of Farmland Capital Construction

The task of farmland capital construction in low mountain and hill regions is a very great one, and the job of hauling cement, sand, soil and rock for water and soil conservation and improvement of low yield fields is a very heavy one. Semimechanized hauling equipment such as rubber-tired carts, wheelbarrows and short-distance, powered cable towing lines should be developed first and tractors should be equipped with trailers as soon as possible. In addition, small and medium size tractors should be gradually equipped with earth moving, digging and scraping devices, as well as with plows for digging ditches for gradual improvement in the level of mechanization and semimechanization of operations.

(3) Mechanization of Local Specialties Production and Processing

Throughout the province's low mountain and hill regions are economically diversified bases that produce special local forest products. However, production of these products competes for manpower with grain production. As a result development of economic diversification has been fairly limited. In order to solve this problem, in addition to gradual increase in the level of agricultural mechanization to free labor forces for development of economic diversification, another important aspect is mechanization of the production and processing of special local products. The current foundation for doing this is poor. Though some economically diversified bases have a certain amount of mechanized and semimechanized machinery and implements (such as for tea processing, and ramie harvesting and stripping), most equipment is not integrated into a complete system, is a long way from being commonly used, and is completely lacking in most cases. This task must be made a part of overall agricultural mechanization endeavors. A firm grip has to be taken on the selection and finalizing of the design of machines and implements used in the production and processing of special local forest products. Sites must be established for their prodution, and the supply and promotion of such equipment organized so that use of such mechanized equipment will become fairly widespread during the next several years.

In addition, serious attention must be given to the mechanization of grain harvesting, threshing, drying and processing. Low mountain and hill regions have fairly good water power and small hydropower generation has developed

quickly. Most places are in a more favorable position than plains areas as far as energy is concerned. Therefore, in solving the problem of grain threshing, drying and processing, a program for use of electromechanical methods should be pursued.

4. Mountain Regions

Hubei's mountain regions include two agricultural regions in the northwestern and southwestern parts of the province. Emphasis in mountain region farm mechanization should go first to the flatland areas, with major efforts devoted to "three harnessing" machines [machines to harness rivers, soil and mountains] and to machines for production and processing of special local agricultural sideline products.

(1) Upgrading of Flatlands Agricultural Mechanization First

It is the flatland areas that have always been the grain production bases in mountain regions, and they should be the focus for mountain region farm mechanization. A step-by-step course should be followed from machine plowing, to machine preparation of the soil, to machine hauling in a gradual expansion of operations so that within a relatively short period of time, this region will take a leading role and serve as a model for mountain region mechanization.

(2) Rapid Development of "Three Harnessing" Machines

Harnessing of rivers, mountains and soil in the western Hubei mountain regions and farmland capital construction is an extremely arduous task that requires very great expenditure of manpower because of the low level of mechanized construction. For this reason, energetic efforts must be directed toward development of "three harnessing" machines for mountain regions consisting primarily of small mechanized and semimechanized implements such as drills, rock boring machines, drill rods, explosives, and rubber-tired carts. Such development should be accompanied by the provision of large and medium size mechanized tools such as bulldozers, earth scrapers, and earth levelers that can be used for many jobs and that are urgently needed for "three harnessing" work. Right now, every jurisdiction has some capability to innovate and create small size machinery and implements needed for "three harnessing." They should select the types needed, finalize models, produce them at specific sites, and organize their promotion for use.

(3) Development of Machinery for the Production and Processing of Special Local Agricultural Sideline Products

The western Hubei mountain region is a major base for production of special local products in the province. However, the abundant resources available for economic diversification are still far from being used to the full. By way of solving the problem of competition for manpower between economic diversification and grain production, the masses of this region have carried out innovative experiments with production and processing tools for certain local special products, achieving a certain amount of success. Wufeng County,

for example, has changed over gradually from the former hand rubbing of tea to a hand-operated machine for rubbing tea, foot operated machines for rubbing tea, tea rubbing machines pulled by oxen, and even to today's mechanized tea rubbing machines. This is one example. Caihua Commune in the same county has reported an annual saving of more than 30,000 man hours from the mechanization of tea processing alone. Not only has this brought about development of tea production, but grain production has also climbed. This shows that going in big for the mechanization of special local products production and processing is extraordinarily important for development of both economic diversification and grain production in mountain regions. This should be a major ingredient in future mountain region agricultural mechanization that is given earnest attention.

Since distances through the mountains are large, commune member dwellings scattered, and transportation conditions poor, it is extremely inconvenient for commune members to take their grain to specific sites for mechanized threshing and processing. As a result, this problem has not been solved in numerous mountain regions. The future will require gradual improvement in transportation conditions and an equitable readjustment of processing sites. In addition, it will be necessary to research and develop small processing machines that are small in size, light in weight, work efficiently, and that can be moved about easily. Additionally, in mountain regions potatoes and sweet potatoes constitute a very large proportion of the food supply, so machines must be provided for slicing, pulverizing, powdering, and drying them.

The western Hubei mountain region has plentiful water power resources. Conditions for development of small hydropower plants are superior. For this reason, processing of both grain and special local products should be done electromechanically.

(4) Energetic Development of Transportation Machinery

Development of machines for transportation is a crucial issue in the development and building of mountain regions. However, poor road conditions and low economic levels in mountain regions make for numerous difficulties. Future work should proceed from realities in mountain regions, with the focus of developing machines for transportation being placed on communes. Those communes already having fairly good road conditions, and those regions where commune production of special local forest products is concentrated, in particular, should be first to be equipped with some trucks and wheeled tractors for farm use and be given help in developing steel cableways, ground slides and such transportation tools.

Third Section. Linking Farm Machines and Agronomy

Development of agricultural production toward modernization makes for an ever increasing closeness between farm machines and agronomy. The better farm machines and agronomy are combined, the higher the level of agricultural modernization demonstrated. It is necessary to proceed from realities in Hubei Province, study both domestic and foreign experiences, and steadily study problems in combining farm machines and agronomy.

1. Gradual Increase in Associated Equipment for Tractors and Steady Rise in Tractor Applications

Improvements in the farming system and farming techniques, promotion of superior varieties with different properties, strengthening of plant production work, and more rational use of fertilizer require versatile farm machines, and use of greater amounts of associated farm machines and implements that are capable of performing diverse operations. For this reason, the key to whether existing tractors will be able to play their full role lies in how much associated equipment is provided. The greater the amount of associated equipment, the greater the number of operations that can be performed, and the greater the versatility. Conversely, the fewer the pieces of associated equipment, the more limited the operations, and the poorer the versatility. Today the province has few complete sets of farm equipment, the amount averaging only 1:2.2 for the province as a whole. Moreover, it has only single models of limited versatility. Decisive and effective action must be taken for a gradual turnaround of this backward situation; otherwise, the equipment will meet farm production needs less and less. One way of solving the problem is to rely on the farm machinery industrial sector to make planned proportional arrangements for production of complete lines of farm implements, and to proceed from the present foundation to an all-out effort to increase varieties and models in accordance with needs for development of agricultural production. A second way is to rely on an all-out mass campaign of innovation everywhere to turn out more and better farm implements to meet local production needs. During the past several years, many places have had a certain amount of success in this regard. For example, flat ground harrows and cotton cultivators produced in Xinzhou County, and interchangeable machine chassis and ditchdiggers produced in Mianyang County have played very large roles in production. A look at research and development of such complete sets of farm implements everywhere during the past several years shows a single experience deserving serious attention, namely that complete sets of farm machinery and implements must be in keeping with China's agricultural traditions of intensive farming; otherwise, the equipment will not be welcomed by the masses and will not spread. Therefore, future solution to the complete equipment problem requires extremely serious attention to the performance and role in farming of machines and implements, with every effort bent to make machine operations meet intensive farming needs, and be valuable for promotion elsewhere.

2. Agronomy Reform Needs To Fit in With Farm Machine Operations

To the maximum extent possible, reform of agronomy will have to meet requirements of farm machine operations. This is a striking characteristic of modern agricultural production. Without use of machines, there is no use talking about the modernization of agriculture. The problems Hubei Province faces in this regard at the present time include, first, a restructuring of the farming system and second, the interplanting issue. In recent years, restructurings of the farming system have been too frequent in some places, particularly with regard to the distance between rows, the distance between plants, and dimensions of furrows when intercropping cotton and wheat. Every year changes are made. Machines and implements readied for the first year cannot be used the second year. If this situation continues, machines will be available, but there will be no place to use them. Farm machines and agronomy must be unified, with specifications set that suit the needs of both, which should then be maintained relatively stable. Right now a fairly complex issue is how to solve problems in the mechanization of interplanting. No other way exists except to make efforts with both farm machines and agronomy. For example, in order to gain high yields of both grain and cotton when wheat and cotton are interplanted requires, from the standpoint of farm machinery, that something be done about the mechanization of transportation to the point of transplanting the nutrient pots in which the cotton seedling have been grown so that there will be continuous cropping in the interplanting of wheat and cotton. Looked at from the agronomy angle, early maturing varieties of wheat and cotton should be developed and the maturing times staggered to fit in with needs of farm machinery operations.

3. Development of Agricultural Production in the Direction of Specialization and Socialization

For the mechanization of agricultural production, to a certain extent the number of crop varieties planted cannot be too numerous or too complex. Today some places that have a considerable number of farm machines already feel many conflicts resulting from crop patterns that are "small but all-embracing" in some communes and brigades, and this seriously impedes further development of agricultural mechanization. With increase in the speed of agricultural mechanization, this conflict will likely come more and more to the fore. While maintaining its existing basic accounting units, Lianhe Commune in Xinzhou County adapted general methods to local circumstances in the layout of its crops. In some places cotton was dominant; in others paddy rice; in still others economic diversification was dominant. As a result, the varieties of crops and arrangements for them were relatively centralized. Corresponding changes were made in the former labor units with establishment of specialized teams for a gradual transition to specialized agricultural production. This reduced the complexity of operating farm machines were required to perform, and increased the utilization rate for complete sets of farm machines and implements bringing about in-depth development of agricultural mechanization. This commune's methods merit serious attention. They show that the modernization of agriculture requires changes in the methods of a small scale agricultural economy in being "small but

all-embracing" with a small sphere, and gradual rise in the level of specialization and socialization in agricultural production to set the stage for better linking of farm machines and agronomy so that agricultural production as a whole will achieve higher economic effectiveness.

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